// AGRICULTURAL ENGINEERING

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H. B. WALKER, President RAYMOND OLNEY, Secretary-Treasurer

Vol. 5 DECEMBER, 1924 No. 12

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The Object and Scope of A. S. A. E. Activities

THE American Society of Agricultural Engineers was organized in December, 1907, at the University of Wisconsin by a group of instructors in agricultural engineering from several state agricultural colleges, who felt the need of an organization for the exchange of ideas and otherwise to promote the advancement of agricultural engineering. The object of the Society, as defined by the Constitution, is "to promote the art and science of engineering as applied to agriculture, the principal means of which shall be the holding of meetings for the presentation and discussion of professional papers and social intercourse, and the general dissemination of information by the publication and distribution of its papers, discussions, etc."

The membership of the Society represents all phases of agricultural engineering, including the educational, professional, industrial, and commercial fields.

The scope of the Society's activities embraces both the technical and economic phases of the application of engineering to agriculture, and is comprehended in the following general headings:

(a) Farm Power and Operating Equipment—power, implements, machines, and related equipment.
(b) Farm Structures—buildings and other structures and related equipment.
(c) Farm Sanitation—water supply; sewage disposal; lighting, heating, and ventilating of farm buildings, and related equipment.
(d) Land Reclamation—drainage, irrigation, land clearing, etc., and related structures and equipment.
(e) Educational—teaching, extension, and research methods, etc., employed in the agricultural engineering field.

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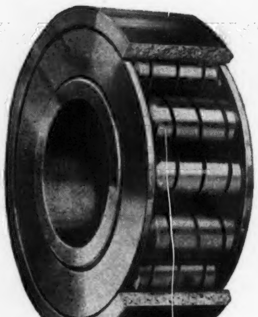

AGRICULTURAL ENGINEERING

The Journal of Engineering as Applied to Agriculture

RAYMOND OLNEY, Editor

Vol. 5 DECEMBER, 1924 No. 12

EDITORIALS

Temple Bill

THE Temple Bill, which provides for the completion of the general topographic map of the United States has been introduced in Congress a number of times. At the last session of Congress the bill was given a hearing, the only hearing it ever had, and the committee in charge made a favorable report on the bill. This is the first favorable report and paves the way for enactment into law early in the session of Congress to convene this month.

The bill provides that the completion of the topographic map be accomplished in a period of twenyt years, continuing the U. S. Geological Survey's quadrangle sheets. Many engineers do not know that due to haphazard appropriations only thirty-five per cent of the country has been covered in a period of forty years of work. The maps now published are a great improvement over the earlier ones. It is pointed out that by keeping a force employed steadily much money will be saved in completing this piece of work.

A significant thing in connection with the Temple Bill is the fact that the United States is the only great country without an adequate map on which to plot our progress or the nation's defence.

Because of the importance of this project it is urged that the members of the American Society of Agricultural Engineers write or personally interview their representatives in Congress, pointing out the need of such a map and the important uses to which it can be put and urge their support in seeing that the Temple Bill is enacted into law. Such action on the part of agricultural engineers must be immediate and universal to produce the desired effect. At the annual meeting of the Society held in Chicago, November, 1923, a resolution was passed urging that the Temple Bill be enacted into law.

Inasmuch, therefore, as agricultural engineers appreciate the importance of completing this project, they should get behind it and use their influence in seeing that it passes Congress at this session.

JOHN R. HASWELL

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Development and Research

THE idea prevails generally among agricultural engineers that the immediate future holds in store an unprecedented development in the application of the principles and practices of engineering to agricultural requirements. Whether in the development of new machines, or in the improvement of present types, or in development of new farming methods and practices, etc., the agricultural engineer is confronted with a multitude of problems awaiting solution.

Progress in the field of agricultural engineering today is seriously hampered by the lack of fundamental information and data which is so essential to sound development. Through the columns of this Journal and meetings of the American Society of Agricultural Engineers, attention has been called to the necessity of the development of a strictly agricultural engineering science. This, of course, means research. As so comprehensively outlined in a recent issue of AGRICULTURAL ENGINEERING, the great trouble with agriculture today is that it is not "engineered" anywhere near to the extent it should be. Agriculture of the future must be developed more along sound engineering lines than it has in the past, if it is to be permanent and more profitable and enjoyable to those engaged in it.

It is obvious, therefore, that the development of an engineered agriculture is based on research. A tremendous amount of it is needed.

Research costs money, and requires a great deal of time to accomplish worth-while results. But research is actually paid for, in both time and money, whether or not it is systematically undertaken. A new development or the introduction of a new idea or a new piece of equipment may be considerably delayed if a preliminary program of research is carried out to test thoroughly its practicability and to eliminate the major portion of the "bugs". Nevertheless, such a program of research may mean a tremendous saving in both time and money in the long run. In other words, from the standpoint of economy as it affects all concerned with the particular development, research should logically precede engineering development.

In this issue of AGRICULTURAL ENGINEERING, on page 276, appears the first half of an article which is a history of the research work along agricultural engineering lines that has been undertaken by the state agricultural experiment stations. It represents a great amount of work, but when compared to what needs to be undertaken, it can be said that the surface has scarcely been scratched as yet.

* * *

Society Emblem

"I BELIEVE each man owes it to the profession to which he belongs to give it what publicity he can by wearing the emblem of the society representing that profession." The foregoing is a quotation from a letter received by the editor of AGRICULTURAL ENGINEERING from a member of the American Society of Agricultural Engineers. We wonder how many members of the Society have ever given consideration to advertising the Society representing their profession.

Every A. S. A. E. member feels the necessity of promoting the interests of his Society. One of the principal means of doing that is by publicity, and one of the easiest ways for members to give the Society publicity is through the wearing of the Society emblem.

It does more. It gives the wearer of the pin a standing among those with whom he comes in contact that he might not otherwise get, unless his accomplishments in the field of agricultural engineering were generally known. It is desirable, therefore, that each A. S. A. E. member wear the emblem of the Society.

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Correcting an Error

APOLOGIES are due Arnold P. Yerkes in connection with the article, entitled "Relation of Large Machine Units to Production," appearing on page 248 of the November 1924 issue of AGRICULTURAL ENGINEERING and credited to Ernest B. Haight. It was originally prepared and presented by Mr. Yerkes as a paper, under the same title, before the twelfth annual meeting of the American Society of Agricultural Engineers, and was printed in the 1918 A. S. A. E. Transactions (Vol. XII). It was read, however, by Mr. Haight before agricultural engineering seminar at the University of Nebraska in 1923 and upon inquiry Mr. Haight states that he is not the author of the article as was incorrectly credited to him in the November issue.

Motorizing the Corn Crop in Ohio*

By G. W. McCuen

Mem. A. S. A. E. Professor of Agricultural Engineering, Ohio State University

THE question of economic corn production is a very interesting one and has presented problems of many ramifications for study. One of the big problems is the labor shortage on the average farm; the price asked these days largely prohibits hiring any. In farming or any manufacturing enterprise there are two great items in the cost of production to be considered: the fixed expenses and the operating expenses. The fixed expenses cannot be reduced to any extent, and yet carry on the farming operations efficiently. The operating expenses can be controlled to a large degree by the careful selection of machinery and power for the work to be done. According to Illinois Bulletin No. 231, 80 to 90 per cent of the total operating expense consists of man and horse labor.

The cost of labor can be curtailed largely by the use of power machinery. The failure to effect a proper balance of power, as between horses and tractor, on the average farm is the cause of both not being used to the greatest degree of economy. A common assertion that non-tractor farmers make is that it is easy to break and prepare all the ground that can be properly cultivated, so the tractor does not fit into their program satisfactorily. Cultivating is the neck of the bottle which restricts the larger use of the tractor. The peak load of farming comes during the last part of May and first of June. A motor cultivator reduces this peak, and the corn crop is cultivated expeditiously, leaving ample time for the care of alfalfa and other hays.

The question of saving man-hours labor or increasing the labor output of a man was studied recently in corn crop motorization by the department of agricultural engineering at Ohio State University. The problem as it was originally outlined and approved by the dean of the college of agriculture was to make a direct comparitive study of horse and motor equipment in the same field under the same conditions, all operations to be carried on simultaneously. However, shortly after plowing had been started the horses were withdrawn and we found we were studying only motorization. Instead of motorizing 15 acres, 30 acres were studied making the results still more conclusive.

The equipment used was a 30 horsepower tractor, a three-bottom 14-inch plow, an 8-foot tandem disk harrow, a 10-foot soilpacker, a 10-foot spike-tooth harrow, a 10-foot five-plank float, and a motor cultivator with planter attachments.

The data obtained were on the following field operations: plowing; double-disking and packing; double-disking, harrowing and planking; planting, and cultivating four times.

The field was an old aviation field covered with a thick heavy sod. It is needless to say that this ground plowed extremely hard. A depth of 6 inches was maintained in plowing. The ground was plowed early in April so that the sod would disintegrate somewhat before the planting season.

The first seedbed preparation was completed about May 8 using a tandem disk and soilpacker in combination. The night before planting was to start a heavy beating rain fell compacting the ground to such an extent that it had to be refitted. The tandem disk, spike-tooth harrow and plank float were used in combination the second time over. In the table that follows it is interesting to note the effect that good solid footing has on the amount of work that is accomplished in a unit of time.

The planting of corn with a motor planter is a pleasure. With but little physical effort on the part of the operator the rig is easily handled and straight rows can be driven. Some slight changes in the arrangement of the seat were made. The corn was checked.

The first cultivation of the corn was made the last day of May. The field was river bottom land, and it was quite foul with all sorts of weeds, so it was necessary to start cultivating when the corn was very small. The first cultivation, being the critical one in my opinion was carefully made. The motor cultivator was driven at a very slow speed and excellent work was done. The mule-hoof type of shovel was used throughout all cultivations. The rate of the subsequent cultivations increased gradually. A greater speed could probably have been obtained, but the first requisite was thorough cultivation, speed being secondary.

The following are data on the different operations. The labor charges are for the care and operation of the tractor at 30 cents per hour, kerosene at 15 cents per gallon, gasoline at 20 cents per gallon, lubricating oil at 87 cents per gallon and grease at 15 cents per pound. The acres per hour is based on running time and the care of the machinery is accounted for in a separate item.

1. Operation of Plowing.

0.86	acres per hour, or 1.16 hours per acre.
4.37	gallons kerosene per acre.
0.037	gallons gasoline per acre.
	Cost Items
$ .03	care per acre.
.348	labor per acre.
.655	kerosene per acre.
.195	grease and oil per acre.
.007	gasoline.
$1.235	total cost per acre.

2. Preparation of Seedbed (First Time).

1.96	acres per hour, or 0.51 hours per acre.
1.85	gallons kerosene per acre.
0.016	gallons gasoline per acre.
	Cost Items
$ .0224	care of tractor per acre.
.1530	labor per acre.
.2775	kerosene per acre.
.0366	grease and oil per acre.
.0003	gasoline.
$ .4898	total cost per acre.

3. Preparation of Seedbed (Second Time).

3.1	acres per hour, or 0.32 hours per acre.
2.24	gallons kerosene per acre.
0.016	gallons gasoline per acre.
	Cost Items
$ .0226	care of tractor per acre.
.0960	labor per acre.
.3360	kerosene per acre.
.0446	grease and oil per acre.
.0003	gasoline per acre.
$ .4995	total cost per acre.

4. Operation of Planting.

1.50	acres per hour, or 0.656 hours per acre.
0.95	gallons gasoline per acre.
	Cost Items
$ .0361	care of motor planter per acre.
.1968	labor per acre.
.1900	gasoline per acre.

*Paper presented at the eighteenth annual meeting of the American Society of Agricultural Engineers, Lincoln, Nebraska, June, 1924.

.0390 grease and oil per acre.

$ .3619 total cost per acre.

5. Cultivation (First Time).
   0.93 acres per hour, or 1.07 hours per acre.
   0.65 gallons gasoline per acre .
   Cost Items
   $ .0390 care of cultivator per acre.
   .3225 labor per acre.
   .1300 gasoline per acre.
   .0265 grease and oil per acre.

   $ .5180 total cost per acre.

6. Cultivation (Second Time).
   1.19 acres per hour, or 0.84 hours per acre.
   0.87 gallons gasoline per acre.
   Cost Items
   $ .0177 care of cultivator per acre.
   .2520 labor per acre.
   .1740 gasoline per acre.
   .0263 grease and oil per acre.

   $ .0470 total cost per acre.

7. Cultivation (Third Time).
   1.41 acres per hour, 0.709 hours per acre.
   1.01 gallons gasoline per acre.
   Cost Items
   $ .0216 care of cultivator per acre.
   .2127 labor per acre.
   .2020 gasoline per acre.
   .0296 grease and oil per acre.

   $ .4659 total cost per acre.

8. Cultivation (Fourth Time).
   1.80 acres per hour, 0.552 hours per acre.
   0.80 gallons gasoline per acre.
   Cost Items
   $ .0066 care of cultivator per acre.
   .1656 labor per acre.
   .1600 gasoline per acre.
   .0250 grease and oil per acre.

   $ .3572 total cost per acre.

Recapitulation (Operating Expenses Only)

	Operating Costs per Acre	Acres per Hour
Plowing	$1.235	0.86
First seedbed prepartaion	.490	1.96
Second seedbed preparation	.500	3.10
Planting	.362	1.50
First cultivation	.518	0.93
Second cultivation	.470	1.19
Third cultivation	.466	1.41
Fourth cultivation	.357	1.80
Total	$4.398	

As explained previously, in the above table the cost items are care of the tractor, labor for operating, fuel, and lubricants. The acres per hour are based on actual running time including time for field adjustments. Many will say this is not the true cost as depreciation, interest, etc., must be considered. Depreciation on farm implements is an extremely variable factor. It may be said that depreciation varies directly with the appreciation of the operator. However, the accompanying data on depreciation, interset, etc., are based on information obtained in U. S. D. A. Farmers' Bulletins Nos. 997, 963, 1298, and 1295, New York (Cornell) Bulletin No. 405, and unpublished data of Ohio State University.

Table Showing Cost and Average Life of Equipment

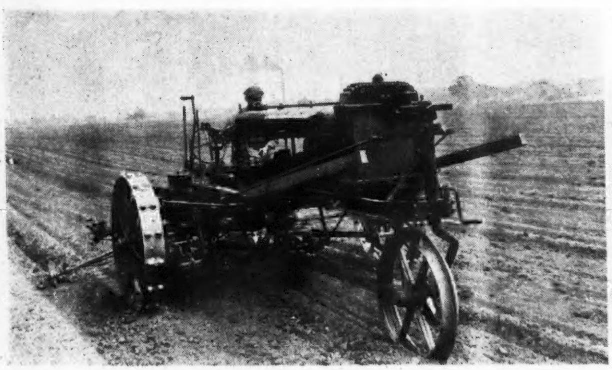
Implement	Cost	Average Life
Tractor	$1285.00	6 years
Plow	155.00	8 "
Disk Harrow	134.00	8 "
Spike-Tooth Harrow	25.20	10 "
Soil Packer	120.00	10 "
Planter	60.00	10 "
Motor Cultivator	750.00	8 "

Table Showing Interest, Depreciation and Operating Charges for Various Operations

	Interest and Depreciation	Operating	Total
Total Cost of Plowing (All Charges)	$1.4000	$1.2350	$2,635 per acre
" " " Disking and Packing	0.6230	0.4898	1.112 " "
" " " Disking and Harrowing	0.3654	0.4995	0.865 " "
" " " Planting	0.1863	0.3619	0.548 " "
" " " First Cultivation	0.3053	0.5180	0.823 " "
" " " Second Cutlivation	0.2385	0.4700	0.708 " "
" " " Third Cultivation	0.2013	0.4659	0.667 " "
" " " Fourth Cultivation	0.1567	0.3572	0.514 " "
Total cost per acre through to standing corn	$3.4740	$4.3950	$7.872 " "

Table Showing Itemized Charges for Equipment Used

Cost of Machine	Tractor	Plow	Disk	Harrow	Soil Packer	Motor Cultivator
Interest	38.55	4.65	4.02	0.75	0.75	22.50
Depreciation	214.16	19.37	16.75	2.52	12.00	93.70
Repairs	41.12	9.00	1.55	0.00	1.20	22.50
Total Cost per Year	293.83	32.02	22.32	3.27	16.80	138.70
Cost per Hours Use	0.979	0.228	0.139	0.024	0.105	0.284



These pictures show the author of the accompanying paper, G. W. McCuen, in the midst of gathering information and data on the costs, etc., of motorizing the corn crop in Ohio, the results of which showed the advantage of mechanical power

Table Showing Average Use of Equipment

Average use of Tractor	300 hours per year
Average use of Plow	140 hours per year
Average use of Disk, etc.	160 hours per year
Average use of Motor Cultivator	488 hours per year

These data were obtained under ordinary farm conditions The weather had to be contended with, conditions were far from being ideal, the season being wet and backward. The cost of seedbed preparation is rather high due to the fact that the ground had to be refitted as previously mentioned. The yield of corn was 65.5 bushels per acre. Putting the cost on a bushel basis each bushel cost 12 cents to produce it on the stalk standing. Suppose the yield had been only 40 bushels (the average of the two counties studied.) Then the cost would have been 19.6 cents per bushel. There is still a chance for profit. This is not excessive when the man-hour saving is considered.

The large saving of man-hours in all the different operations is remarkable, especially in cultivation which is the bottle neck or peak load of farming in Ohio where wheat and hay are grown. In unpublished data compiled last year on the use of two-row horse cultivators in Greene County, it was found that the man-labor output was increased 59.16 per cent.

For the sake of fairness let us compare these data. The man-hours per acre, using a two-row horse-drawn cultivator would be 4.36 hours, and that of motorization 3.41 hours or an average saving of 0.95 man-hours per acre. Let it be assumed that 80 acres of corn is raised. Then there is a saving of 76 man-hours, or more than a full week's time.

There is no comparison between the two outfits in the last two cultivations because of the speed factor. It has been my observation, collaborating with the observations of the department of rural economics at Ohio State University, that in the final cultivations a man can cover 50 per cent more acreage a day with a motor cultivator than can be covered with horse-drawn equipment. Is this not a factor when hay and wheat are crowding the farmer? Many of these advantages cannot be given a monetary value, but the farmer that looks well to the timely doing of farm work cannot use the farm tools of yesterday's agriculture, but must look to the tools of tomorrow's agriculture to produce economically.

A Terracing Project in Indiana

A TERRACING demostration was held recently on the Henry Kahre farm in Vandenburg County, Indiana, under the direction of T. E. Hienton, agricultural engineering extension specialist at Purdue University and the local county agricultural agent. This particular field was selected because one field on the farm was in as bad condition as any field in the county, also because it was located on one of the main highways where its purpose as an object lesson to other farmers would be served more effectively. The field had not been cultivated for many years and had been turned into a permanent pasture of Japan clover. The clover had checked the erosion in a few places, but the gulleys in most parts of the field were very bad, some of them being deep enough to completely conceal a horse and rider.

In four days time, working three teams and three men continuously, besides the county agent and extension specialist, the field consisting of about 15 acres was terraced so that further erosion would be prevented.

The cost of the work, figuring $5.00 a day for team and driver, was approximately $60.00 for the entire project.

If properly handled from now on this field can be brought into permanent pasture or cultivation, making it just as valuable as some of the other land located near it. The owner plans to sow it to rye, top dress it with manure, and put on an application of limestone. In the spring the rye will be turned under and soybeans planted. The soybeans will be followed by wheat, which will be sown to clover and will be followed by a crop of corn. By using this rotation it is hoped to bring the field back to profitable cultivation.

Since completing this demonstration of terracing, there have been several calls from farmers in the vicinity for similar demonstrations on their farms.

A Three-Million-Acre Drainage Project

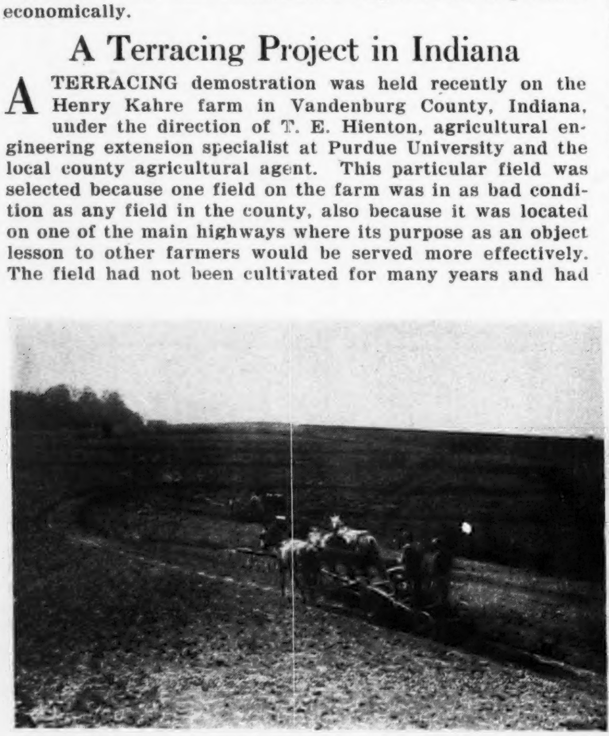
WHAT engineers describe as the world's greatest drainage-reclamation project is now nearing completion at an ultimate total cost of more than $50,000,000. Nearly 3,000,000 acres of swamp lands in the St. Francis River basin of southeastern Missouri and northeastern Arkansas will have been made tillable.

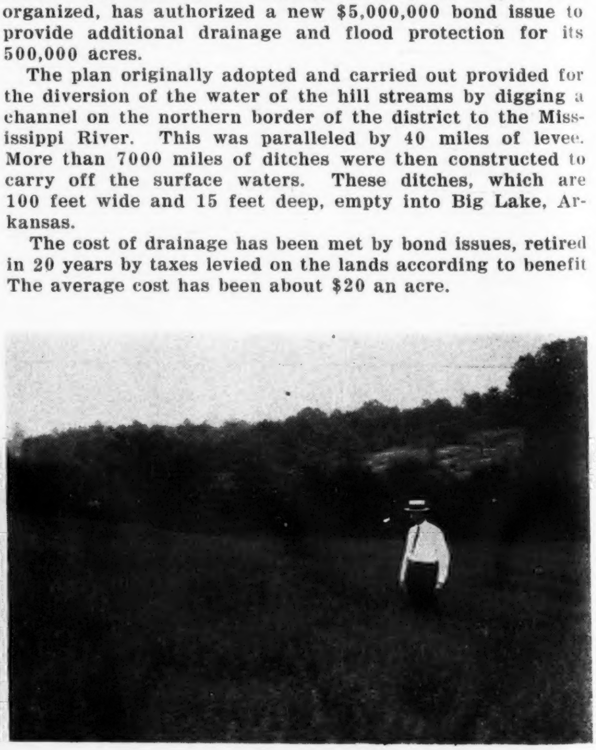
Excavations will total upward of 500,000,000 cubic yards, according to engineering estimates, or more than in the construction of the Panama Canal. Lands which were virtually worthless now are valued at from $40 to $100 an acre. Corn wheat, cotton and numerous other crops are successfully raised on the soils built up by deposits brought down by the Mississippi and other large rivers.

With the removal of stagnant water, the mosquito has disappeared and homeseekers have poured in by the thousands. The Little River drainage district, the largest ever organized, has authorized a new $5,000,000 bond issue to provide additional drainage and flood protection for its 500,000 acres.

The plan originally adopted and carried out provided for the diversion of the water of the hill streams by digging a channel on the northern border of the district to the Mississippi River. This was paralleled by 40 miles of levee. More than 7000 miles of ditches were then constructed to carry off the surface waters. These ditches, which are 100 feet wide and 15 feet deep, empty into Big Lake, Arkansas.

The cost of drainage has been met by bond issues, retired in 20 years by taxes levied on the lands according to benefit The average cost has been about $20 an acre.





Saving the Washed Lands of Indiana. This picture shows (left) terraces in the process of construction in a Southern Indiana field. (Right) Terrace covered with alfalfa. Compare with washed field just beyond

Professional Agricultural Engineering Service

By Stanley F. Morse

Mem. A. S. A. E. Consulting Agricultural Engineer

SOME twenty years ago when I confided to my old professor my plans for becoming an agricultural consultant, he smiled and said: "This means that you will have to be a pioneer, and the pioneer is like the fellow who first attempts to climb a greased pole; he wipes off the grease, but the next man climbs the pole and wins the prize." At present the profession of consulting agricultural engineer is still in the pioneer stage, because it is not yet generally recognized as an established profession, and those who need its services have not yet become accustomed to paying for them. However, the work itself is fascinating and offers a wide field of development.

The agricultural engineer, consulting agriculturalist, farm consultant, or whatever he may be called, is the logical outcome of the county agricultural agent service. As a director of extension I found that county agents had so much work to do they could not give to any one farmer the amount of time and thought needed to do a thorough job. Extension workers also find that they are unable to meet the constant calls for special service. But there is great need for the service which only a consulting agricultural engineer is able to render. For instance, a company with, say, 10,000 acres of land, wants to know, first, whether it can be developed profitably and, second, how. It is not enough to determine that certain crops, livestock, and types of farming are adapted to the land and other local conditions—but will the proposed development pay? Then come the preparation of detailed working plans and the skilful supervision of the development work. This may involve the handling of funds, the purchase of materials, the hiring of men, and other strictly commercial activities which are outside the scope of the agricultural college; in other words, the agricultural engineer translates into action and dollars-and-cents results the sound agricultural practices advocated by the agricultural experiment station and carried to the farmer by the extension division when he modifies them to suit local conditions, coordinates them with existing farm practices, and assists in working out the financial and administrative details of successful business management.

Many special phases of agricultural consulting work are being developed along such lines as soils, chemistry, entomology, plant pathology, livestock, engineering, economics, horticulture, etc., but these are adjuncts to the agricultural service engineer, the coordinator who sees to it that the various enterprises under consideration are properly balanced and whose prime function is at all times to see the relation of every operation to practical results, costs, and ultimate net profits. Briefly, his work may be summarized as follows:

1. **Inspections and Reports.** Inspections of lands and agricultural enterprises of all sorts must be rapid, thorough, and accurate, and his reports must be concise, comprehensive, and business-like. His wide knowledge of varying agricultural conditions and unbiased viewpoint help him to draw correct conclusions and make practical, economically sound recommendations.

2. **Planning Ahead.** In making plans for developing new lands or improving going farms or plantations every possible contingency must be foreseen and amply provided for. Estimates and budgets must accompany all plans. Many agricultural enterprises have failed for lack of accurate knowledge of local conditions, costs and probable hazards, and it is the business of the agricultural engineer to determine these factors in advance and plan accordingly. This is where his consulting experience counts.

3. **Supervising and Managing.** He is often retained to supervise the proper carrying out of development plans prepared by him, requiring regular inspections, checking of work, requisitions, costs, personnel and reports; conducting field experiments and demonstrations and consulting with the officials of the concern. Sometimes he has to take the full management of an agricultural property, being responsible for results.

4. **Special Investigations and Other Work.** The variety of work that an agricultural engineer is called upon to do is surprising, and includes making appraisals of agricultural properties for loans; investigating non-paying estates; determining causes of crop failures or refractory soils; finding a remedy for disease or insect pests; planning and organizing an agricultural experiment station or a department of agriculture; surveying a territory to determine whether a fertilizer company may increase its sales; assisting an implement company to develop a market for its equipment; investigating agricultural companies for bankers; making agricultural surveys for railroads and chambers of commerce; organizing farmers' associations and acting as consultant to them; preparing special investigations; preparing colonization plans for a lumber company.

5. **Location of Work.** Four types of agricultural consulting work have been developed:

(a) The general consultant whose wide experience and special knowledge of commercial agriculture enable him to serve mainly large companies engaged in the production of sugar, cotton, rice, rubber, wheat, cattle, and other staples. This work usually involves much traveling.

(b) The consulting agricultural engineer devoting his time in a farming district, largely to supervising and managing farms within a radius of a hundred miles or so. Most of these are farms operated for profit by individuals or small companies or controlled by banks.

(c) The soil specialist or consulting entomologist-pathologist who has both transient and regular clients.

(d) The agricultural consultant who principally serves the city owners of country estates by providing supervision, management, purchasing and accounting service, saving the owners money and the bother of supervision.

One of the interesting features of agricultural consulting work is its variety. Conditions, problems, and the human factor differ greatly while some engagements involve travel to foreign countries and life among primitive people and conditions. Huge areas of land and investments totaling hundreds of thousands of dollars are devoted to agricultural production in the west, south, and the tropics. The work may be rigorous, full of hardships, disagreeable, and even dangerous, but it is always absorbing and appeals to the red-blooded man who delights in outdoor life and working with nature.

6. **Securing Business.** Giving service to clients is only a part of the agricultural engineer's work. A very important part is that of securing new business. Under present conditions he must locate his prospects, sell them the idea of using the services of a consulting agricultural engineer and then sell them the service. Various means are used to accomplish this. Publicity must be secured through advertising, letters, personal calls, writing articles, lecturing, and the good word of clients. Men who have been in state or federal agricultural work where requests for agricultural service come to them unsolicited and their salaries are not directly dependent on their own efforts do not realize to what an extent this feature of the agricultural consulting profession is essential to its very existence.

The development of this profession will be greatly hastened when the agricultural colleges and the United States Department of Agriculture recognize it as a distinct and essential profession and realize that its development will strengthen their work. It must be evident that there is a limit to the extent to which state and federal funds may

be used to give special service to farm operators. There is no other industry which has received as much free technical service from the government as agriculture, yet other industries have progressed much further without its help. The reason for this is that they have become self-reliant and self-supporting, maintaining their own research departments with highly trained men, the products of our technical schools, including state colleges. Thus the General Electric Company spends $1,000,000 a year for research and the American Telephone and Telegraph Company and others keep abreast of the times with their own research departments. The technical schools do not attempt to do the work of engineers and chemists, nor do the law schools practice law—they turn out trained men who practice their respective professions. So if men trained by the agricultural colleges can render a service to farm owners which is worth paying for, the cost of such service should be borne by the man for whom the work is done just as one pays for the services of a doctor, lawyer, or engineer. A step in this direction has already been made in the case of the county agents who are now partly supported by contributions from the farmers themselves through their county farm bureaus. The next step will probably be for local farmers' organizations to employ agriculturalists. Then will come the private consulting agricultural engineer in close touch with and recommended by the agricultural college and at the same time relieving the college of much work and expense.

Some Essential Requirements for Consulting Agricultural Engineers

Even if there were a strong demand for the services of consulting agricultural engineers, it would be difficult to find properly qualified men to meet it. A man intending to enter this profession should not only have the "robust physical health and a strong physique that will enable a man to endure hard work, hardship, mental strain and long-drawn-out periods of close application to confining tasks" but he should also have "a good intellect with the ability to grasp quickly and analyze correctly the problems encountered, the power of keen observation, and the strong moral qualities of integrity, truthfulness, courage, patience, persistence, energy, sympathy, tactfulness, courtesy, an even, pleasant disposition, and common-sense." He should also have been farm raised or have had practical farm experience.

Those who have specialized in farm management probably have had the best available training for this profession. However, it should be possible to arrange a course which would especially fit men for this work. Such a course should not only be strong in the fundamentals of good agriculture but should lay great emphasis on engineering, economics, farm management, and accounting. Also instruction should be given in the technique of making inspections, reports, development and operating plans, budgets and other practices of the agricultural engineer with plenty of practical field work.

However, no man is competent to practice as a consulting agricultural engineer until he has had at least five and better ten years of field experience. The greatest asset of the consultant should be his sound judgment, his business sense, his familiarity with a great variety of conditions and problems, and his knowledge of different agricultural practices and devices, all the result of long experience. How is one to gain such experience? The best way would be to work as an assistant in the office of an established practicing consultant, but there are probably not a dozen such men in business in this country and most of them are operating as individuals, not with organizations. The only other qualifying experience would be as county agent, extension agronomist, or farm management specialist, or as agriculturalist for a railroad or bank. But in none of these lines can one gain the special commercial experience peculiar to the profession. Perhaps some of the present consultants may begin to build up organizations which will create openings for assistants while other properly qualified, well-trained men who have some capital or income from other sources may start consulting work in a small way especially after several years of county agent experience. One method would be for those intending to take up this profession to secure enough special training in engineering to be able to plan and install drainage, irrigation, and terracing systems, lay out farms, design and construct farm buildings, roads, bridges, and agricultural machinery. Then they might be able to gain a foothold in agricultural engineering work and gradually acquire the experience needed for general consulting practice. Another plan is where a man is fortunate enough to own a paying farm and does consulting work on the side until he has built up a practice.

To a man who has been in state or federal agricultural work the great attraction is being free of government red tape and able to get results in the most direct way. The consulting agricultural engineer is his own boss and knows that by his own efforts he may increase his income, he may seize business opportunities and he is acquiring experience and a habit of self-reliance that will be of value to him in any line of work. On the other hand, he has to deal with an industry about which most people think they know as much as the next fellow. The reason why so many business men fail in farming enterprises is that they have preconceived notions regarding agriculture based on theories and its apparent simplicity. And then most farmers and others are so accustomed to getting free information that they will not pay for consulting service. This work also involves being away from home a great deal. The greatest drawback to establishing one's self in this profession under present conditions is that three to five years must be allowed for working up a paying clientele even where a man is an experienced consultant. This means that he must have either adequate capital to tide him over this period or else a living income from other sources.

Once established the financial returns from this profession are usually greater than from positions in extension or county agent work. But even if the income is the same as from college or government work, the consultant is at least independent. The young agricultural engineer may properly charge from $10 to $25 a day and expenses. The fees of the more experienced man will range from $25 to $50 a day, while the consultant with a reputation may command up to $100 a day and expenses. A desirable arrangement is being retained by enough clients on an annual basis to insure a basic living income. The profession of consulting agricultural engineer while offering an extensive field for service and interesting work should not be taken up by those who dislike hard work or want to get rich quick.

Clay Products Institute Established

THE clay products industries of the country have just recently completed the federation of various branches of the industry which will be known as the Clay Products Institute. The membership in the institute consists of trade associations devoted to the manufacture of clay products and includes the American Face Brick Association, Clay Products Association, The Common Brick Manufacturers Association, The Hollow Building Tile Association, National Paving Brick Manufacturers Association, and National Terra Cotta Society. The purpose of this federation is threefold: (1) For the development of the clay products industry; (2) to provide means for cooperative research work for the improvement of its products, the reduction of manufacturing costs, and to insure better service and consequent public economies; and (3) to afford a point of contact with government bureaus and such institutions and organizations as may be found to be helpful in carrying out the purposes of the institute.

The institute has its headquarters in the Conway Building, Chicago, and the following officers have been selected to direct the activities of the organization: F. W. Butterworth, president; W. P. Whitney, vice-president; and J. S. Sleeper, secretary-treasurer.

The first meeting of the Clay Products Institute, following its organization, will be held January 22 and 23, 1925, at Washington.

Development of Marl Excavating Equipment

By H. H. Musselman

Mem. A. S. A. E. Professor of Agricultural Engineering, Michigan Agricultural College

MICHIGAN has a great variety of industries and agriculture. Listed in the agricultural resources of the state is marl, a calcium carbonate material which has already come into the limelight, so to speak, as a factor in the soil-rebuilding program of the state. To see how it finds a place of importance a brief survey of the agricultural situation might be in order.

The soil, generally sandy and loamy, sometimes shows a half dozen types on one farm. For the most part it is productive when properly supplied with manures, and having legumes fitted into the rotation.

Much of the lighter soil has undergone serious depletion in years past due to farming without sufficient livestock, and the production of wheat and other market crops which have reduced the soil to a state of acidity which makes it difficult to get the soil-building crops started.

Due to the acidity of the soil the use of lime is fundamental to the soil-rebuilding program. Lime formations are not general, being found in only a few locations in the state. The cost of lime includes the cost of crushing and the cost of transportation, which requires an outlay of ready cash for its use, and this, to the man on the run-down farm, is a handicap to a speedy rebuilding program.

Fortunately in sections of the state where the soil is light and depleted, lakes and marshes abound in marl. Marl is a grayish material of somewhat the same composition as limestone and varies in its physical characteristics from oozy mud to the hardness of soft limestone. It is extremely sticky and slow drying, and while it pulverizes easily it does not readily disintegrate by weathering.

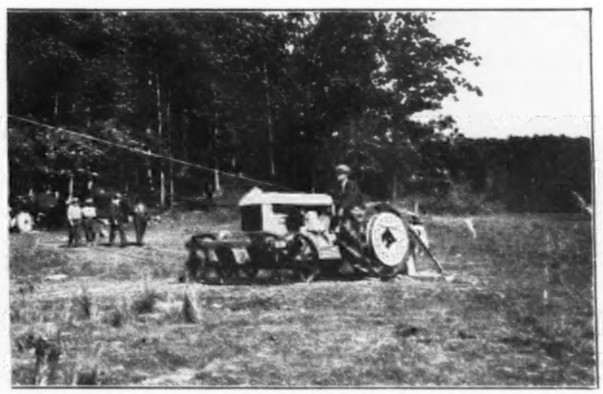
Most of the deposits are overlaid or saturated with water. When it was realized that marl could be used to reduce the acidity of the soil as effectively as lime, efforts were made to make it available. The fact that it was nearly always found in water or in marshes surrounded by soft ground made both excavation and transportation difficult. Furthermore, it was found that even where the deposits could be reached, the physical condition of the marl prevented handling economically and, in some cases, not at all with the equipment available in agricultural sections. Various efforts were made to commercialize the product on a scale which would permit the use of excavating dredges, dryers, and loading equipment, but it was soon found that ahead of a more general use of marl should go an educational campaign on the necessity and use of lime, marl, and legumes, so that these efforts were abandoned.

Isolated cases of the successful use of marl were, of course, being carried on quietly by individual farmers which did not greatly arouse interest in these localities. Many individuals also tried various means of excavating by hand and power but with little success because of the peculiar properties and location of the material. Among the schemes tried were pumping, drag line excavators, slack line cableway excavators, dredges, slip scrapers and horses, wheelbarrows and shovels, wagons run into pits on plank track and hauled out with long ropes attached to the wagon tongues. The pits in the latter cases were pumped continually to remove water seeping into them. In addition to the devices named were some freak ones which cannot be described.

The most promising of these efforts was that of pumping which could be considered successful from the mechanical standpoint, but involves considerable investment and overhead cost for operating. The ordinary methods of agitating were not satisfactory for pumping, inasmuch as the material does not flow. This characteristic was likely to be underrated by engineers. Material into which a cane fishpole could be thrust full length without great effort would stand without slumping in a perpendicular wall ten feet in height even when immersed in water. A special agitator was developed consisting of a rotating propeller-like cutter surrounded by a large hood attached to the end of the suction

Bucket unloading by action of the flexible belt lining of the bucket, which is pulled forward when the push rod strikes the stop block on the track cable. The bucket was designed by agricultural engineers at Michigan Agricultural College

A special hoist adapted to drive by belt from the small tractor; it may be used to operate marl digging equipment



A small tractor may be equipped with comparatively low cost attachments for operating marl digging equipment

pipe. This hood was allowed to sink into the marl which was agitated, mixed with water, and pumped. The hood was then lifted by power and a new hole started. The diameter of this hood was approximately two feet. A tractor and a four-inch centrifugal pump were used for pumping. The nozzle handling equipment was placed on a floating barge and the tractor and pump located on the shore and connected with rubber hose to the suction nozzle.

Where a large investment for equipment in large sizes was permissible, the slack line cableway excavator was possible though generally not economically installed. This type of equipment had two inherent shortcomings. The excavating bucket not under perfect control sometimes sinks into the marl, requiring enormous power to pull the bucket and to overcome the suction in lifting it from the material. The strain on the slack line trolley is also excessive in lifting the bucket, and this requires additional anchorage. The problem of anchorage becomes a puzzling one when it is realized that this anchorage must sometimes be secured in the lake or marsh in the soft marl itself. The cost of anchor cable to reach secure footing across the lake or marsh may also be prohibitive.

An analysis of the problem was made or rather developed by the agricultural engineering department of the Michigan Agricultural College, as the problem grew in importance. The problem seems to have two salient features:

1. The development of a type of excavating equipment adapted to the condition and location of material was necessary.
2. The type of equipment developed should not only make marl available, but should assist in the educational program of promoting its use.

These governing points were further analyzed into several points which served to define the lines of attack. They were set down about as follows:

1. Equipment should be low enough in cost to interest ownership by a single farmer or small group of farmers.
2. Equipment which would handle the material at a cost low enough on small installations to excite interest in a trial, at least, of the material.
3. Equipment should be of a type which can be operated by the farm mechanic.
4. Development of a special low cost bucket which, in small units, would handle the material successfully.
5. Development of a type of equipment which would minimize the problem of anchorage.

After several trials of the centrifugal pump, it was thought that power requirements were too high and the factor of operation too much of an engineering proposition for the average operator.

After a further survey of the work already attempted in the state, the type of outfit selected as best meeting the above requirements consisted of the drag line type, carrying a bucket on an adjustable track cable. This decided, the experiments settled down to designing a bucket which would operate successfully. Practically two years were spent as opportunity afforded for its development. A hay hoist and a 5-horsepower engine were used on the experimental machine. During the summer of 1923 five designs of buckets were built and tried without success.

Along with this development were carried the necessary physical tests of the material as would assist in designing the correct type of digging apparatus. Finally two ideas were hit upon which seemed to solve the two main difficulties, that of controlling the depth to which the bucket cuts and of emptying the bucket loaded with this extremely sticky material.

The first of these difficulties was met with the depth plate set in front of and above the cutting edge of the bucket. This plate was set to raise or give lifting action to the front end of the bucket. By making this adjustable it was possible to slice off a thin layer as the bucket loaded and eliminate suction as a factor to reckon with.

Emptying the bucket proved to be as easily solved. The bucket which had plate sides and a slat bottom and back was lined with a layer of rubber belting fastened only at the cutting edge which was protected by a thin plate. The loose end of the belt was connected to a cable and push rod which was operated by a stop block on the track cable. The unloading was accomplished by pulling the loose end of the bucket lining forward and rolling the marl out of the bucket.

Since it was necessary to carry the weight of the bucket and load only on the trolley cable, anchorage difficulties were reduced. The peak loads in loading and unloading were largely eliminated which also reduced the power required and the size of hoist necessary. The net result as shown in the nineteen demonstrations which were held with the outfit during the past summer, where it was set up and operated in three different locations each week for six weeks, seems to indicate that it has met to a large degree the requirements laid down.

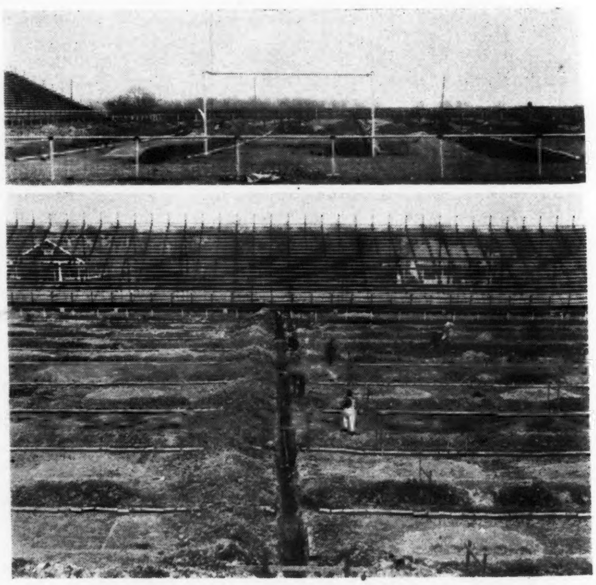
With reduced power and hoist requirements the cost is low enough to permit installation on the individual farm or a small group of farmers working cooperatively.

For operating a special hoist has been developed for use with the small tractor which has been found the most convenient source of power for this purpose.

It is planned to follow the demonstrations which were held during the past summer with installations which will serve to demonstrate the practicability of this method of excavation and to make marl available in sufficient quantities to demonstrate its practical value. It is believed that these installations will serve as centers from which will be broadcasted the merits of marl.

Agricultural Engineers Design Super Under Drainage System

THE department of agricultural engineering at the A. & M. College of Texas was recently called upon to cooperate with the department of physical education in completing an underdrainage system to insure the rapid removal of water after heavy rains from Kyle Field. Ten laterals were laid approximately twenty feet apart, on each side of the main, which crosses the field between the 20 and 30-yard lines. Each of the outside laterals is about eight or ten feet from the boundary line and the surface enters the outside laterals through fourteen surface inlets. The depth of the laterals varies from 1 foot 8 inches to 3 feet 6 inches. The main and laterals were bedded in sand. The fall given was two to three tenths feet per 100 feet. The drainage system was completed at a cost of about $1100.00.



The agricultural engineers at the A. & M. College of Texas engineered the underdrainage system in this athletic field

Farm Machinery Engineers Meet in Chicago

THE meeting of the Farm Power and Machinery Division of the American Society of Agricultural Engineers held at the Great Northern Hotel, Chicago, December 3, was proclaimed by those in attendance as a distinct success. It exceeded in attendance and interest the expectations of those responsible for arranging it. The success of the meeting was particularly gratifying because of the fact that it was the first one of its kind that has ever been held separate from the regular annual meeting of the Society.

There was a total of eighty-nine registered at the meeting, of which forty represented the manufacturers of farm equipment, fourteen represented the manufacturers of allied materials, accessories, etc., nineteen represented agricultural engineering divisions of land-grant colleges and the U. S. Department of Agriculture. The remaining sixteen represented consulting engineers, farmers, press representatives, advertising agencies and trade associations. It was estimated that 40 per cent of those in attendance had never previously attended an A. S. A. E. meeting.

The meeting was formally opened by O. B. Zimmerman, vice-president of the Society, with the following interesting and appropriate introductory remarks:

"Fellow Engineers and Friends: It is with the greatest pleasure that I fulfill the duty of opening this program so carefully prepared by the Meetings Committee and promising such live interest.

"The intensive studies being made of machinery and its applications to agriculture, and now more especially the numerous applications of mechanical power, carry with them the possibilities of applying the successful principles of modern business to every phase of agricultural production. Likewise we are finding that the deepest interest and understanding of scientific principles leads us quickly to find numerous practical applications. The net result is a tremendous speeding up of the accomplishments of man. Each such application brings fruits often so unexpected that experience warrants us in saying 'We scarce can tell what next will appear.'

"Simple care concerning details of the production of corn by boys and girls bring yields which astonish their grandparents. The poultry man starts with his wild hen and a yearly setting of eggs, and today the 200-egg hen is common. Unusual yields of potatoes, beef, pork, grain, etc., are commonly recounted as we develop these possibilities. So with machinery accomplishments we are not standing still. The youth of today masters with ease the powerful machines with intricate working mechanisms taking the place of whole troops of men of the hand-working type. Convenience and time saving as well as cost saving result in their use.

"The genuine interest and encouragement shown recently by our co-workers and friends, the National Association of Farm Equipment Manufacturers, cannot fail to make more complete and professional the work of the agricultural engineers. We extend to them our heartiest invitation to cooperate in the defining and solution of problems of mutual interest.

"Last year our meeting in this same location was the finest example of an engineering society meeting that it ever has been my pleasure to attend, and they have been many and varied. Each and every paper given then was a real masterpiece, full of meat and worthy of an audience of tens of thousands. May this power machinery division do as well today.

"In conforming with our policy, the meeting will now be turned over to our capable chairman of the Farm Power and Machinery Division, Mr. Wirt."

F. A. Wirt, chairman of the Farm Power and Machinery Division, in taking charge of the meeting, made the following pertinent remarks:

"For a number of years the farm-machinery men and the American Society of Agricultural Engineers have wanted a meeting where they could get together and talk over their problems, a meeting where representatives from the manufacturers, U. S. Department of Agriculture, and the agricultural engineering departments of the state colleges, could get together. We see today the fulfillment of that desire.

"I would like to emphasize the opportunity we have today to meet each other. There is always much to be gained by meeting men engaged in the same profession, and we hope that all of you will embrace this opportunity to meet the others in attendance here today.

The first number on the program was a paper entitled "Efficiently Filling the Silo," presented by F. W. Duffee, professor of agricultural engineering at the University of Wisconsin, in which he reported the results of the ensilage cutter tests which he conducted this year. The discussion of Prof. Duffee's paper was led by Mr. H. M. Gehl, of Gehl Brothers Manufacturing Company. The discussion was also participated in by E. Blodgett, of the I. B. Rowell Company; W. B. Condit, of E. W. Ross Company; John Mainland, of Advance-Rumely Company; C. A. Ocock, Avery Company; F. N. G. Kranich, of Timken Roller Bearing Company; Prof. G. W. McCuen, of Ohio State University.

Considerable interest followed by some lively discussions centered in the paper, entitled "Grain Cleaners in Heavy Dockage Areas," presented by Robert H. Black, of the division of grain cleaning investigation of the U. S. Department of Agriculutre. Mr. Black dealt at considerable length with his work in connection with encouraging the development of grain cleaners to combat the serious dockage evil in the spring-wheat states. Mr. Black's paper was well illustrated with lantern slides and a very intesesting moving picture film prepared by the United States Department of Agriculture.

Those taking a leading part in the discussion that followed this paper were J. C. Junkin, of Minneapolis Steel Company; H. W. Worthington, of Advance-Rumely Company; P. W. Morrissey, of J. I. Case Threshing Machine Company; I. P. Blauser, of the University of Illinois; and John Mainland, of Advance-Rumely Company.

The afternoon session was opened by the presentation of a paper entitled "Design of Soil Handling Machinery," by Theo Brown, chief experimental engineer of Deere & Company. This paper dealt chiefly with the fundamental principles in the design of plow bottoms to meet various conditions. Valuable contributions to the discussion following the presentation of Mr. Brown's paper were made by A. C. Lindgren, experimental engineer International Harvester Company; C. A. Bacon, research engineer Oliver Chilled Plow Works; Prof. J. C. Wooley, of the University of Missouri; Prof. H. H. Musselman, Michigan Agricultural College.

Unquestionably one of the most outstanding revolutionary developments in farm machinery in the past few years is the widespread invasion in the territory east of the Rocky Mountains made by the combined harvester-thresher or "combine". In certain states harvesting methods have been completely revolutionized within a few years and machines formerly used are now obsolete. Because of this almost unprecedented development, the paper, entitled "The Combined Harvester-Thresher — Its Development and Future Possibilities," presented by W. F. MacGregor, engineer, J. I. Case Threshing Machine Company, was awaited with a great deal of interest by those in attendance at the meeting. Mr. MacGregor's paper dealt principally with a history of the development of the harvester-thresher in its engineering aspects. An intersting discussion followed this paper led by C. O. Aspenwall, of the International Harvester Company. Prof. J. C. Wooley, of the University of Missouri, in connection with the discussion of the use of the combine principle in the harvesting of soybeans, spoke at considerable length on the problem of harvesting and handling the soybean crop and particularly on the attachment

(Continued on Page 282)

Research in Agricultural Engineering

Research activities in the agricultural-engineering field are presented under this heading by the A. S. A. E. Research Committee. Members of the Society are invited to discuss material presented, to offer suggestions for timely topics, and to prepare special articles on any phase of agricultural engineering research

Evolution and Progress of Agricultural Engineering at the Agricultural Experiment Stations*

By R. W. Trullinger

Mem. A. S. A. E. Specialist in Rural Engineering, Office of Experiment Stations, U. S. Department of Agriculture

AGRICULTURAL engineering has steadily progressed in recent years, first as a teaching subject, then as a service branch, and is now gradually taking its place in the field of investigation at the agricultural experiment stations. Although considerable progress has been made in providing a broad, general background, and to a certain limited extent in formulating purely agricultural engineering principles, the development of inquiry along advanced lines has been slow.

The project lists of the experiment stations show a relatively small but gradually increasing number of projects in the field of agricultural engineering. The latest of such lists includes 162 projects, distributed as follows: Land clearing, 12, drainage 19, farm buildings 19, farm machinery 31, farm power 11, farm water supply and sewage disposal 9, irrigation 36, materials of construction 21, and miscellaneous 4. Twenty-eight experiment stations are represented in this work in the following states: Idaho, Wyoming, Minnesota, Oregon, Wisconsin, Alabama, Illinois, Michigan, California, Mississippi, Montana, North Carolina, Iowa, Kentucky, Indiana, Arkansas, Nebraska, New York, West Virginia, Missouri, New Jersey, Colorado, Utah, Arizona, New Mexico, Nevada, Pennsylvania, and Ohio. The experiment station on the island of Guam is also represented.

The majority of the agricultural engineering projects have until recently been rather elementary, relating to the designs of structures, comparisons of farm equipment or methods, and similar subjects; but such elementary projects have proved to be very necessary in some cases in the evolution of projects of research grade. They have not only served to point out numerous lines of inquiry in which it is desirable that the underlying facts and principles be determined but have brought out the importance of planning and executing investigational work with a logical starting point and a definite aim in each instance.

Farm Machinery

Some of the most striking examples of investigation of a rather elementary character have occurred in the field of farm machinery.

Tractors. Tractors of different types, sizes, shapes, and general characteristics were thrown on the market several years ago. These gradually increased in number and the state colleges and experiment stations were besieged with inquiries. This naturally led to comparative tests of one kind or another to meet immediate demands for information, and at one time national and even international tests and demonstrations of a comparative nature were held.

From these tests the necessity for more specific studies of tractor characteristics in relation to farming requirements became evident. Accepting engine and transmission characteristics and functions as purely mechanical engineering matters, several of the experiment stations began to look into operating characteristics in actual farm work. Considerable general work had, of course, been done previously by commercial concerns in the development of specific tractor types, but nothing of a very fundamental nature had been brought out.

It developed that the relation of lug equipment of drivewheels to traction is one of the most important factors in the farm-tractor problem. Numerous comparative tests of different sizes and shapes of drivewheel equipment were conducted by both public and private institutions at considerable expense, to determine which would give the best results over a wide range of soil types. Among these the tests at the Indiana station (1)** may be particularly mentioned. These and several other similar tests from different sources were described in some detail by R. U. Blasingame in a contribution from the Pennsylvania station (2). These tests indicated the complexity of the problem of traction under farming conditions, and led M. L. Nichols and J. W. Randolph, of the Alabama station, to undertake a study of the fundamental factors influencing the traction of wheel tractors, with particular reference to Alabama soils. This work resulted in the first Adams fund project ever established in this branch of agricultural engineering at a state agricultural experiment station. The first annual report of this project is in course of preparation.

It is significant to note that the main premise adopted in this project was that traction is primarily a function of soil conditions and secondarily of the design of the tractor wheel, evidently a fundamental conception. It was therefore planned to determine first what soil factors affect traction, the relation and valuation of these factors, and more specifically the lines of maximum, minimum, and intermediate resistance to traction in the soil. The next step was to determine the factors of tractor-wheel design, including materials, shape, size, location, and inclination of lugs necessary to meet the soil conditions imposed. Thus the ultimate object was to devise tractor-wheel equipment which would deliver the maximum components of impulsive force along the lines of maximum resistance in the soil.

The results to date, although far from complete, have led to the tentative conclusions that the distribution of impulsive forces in the soil can be accurately determined. The amount and efficiency of traction are increased in sand up to 8 per cent moisture content and are decreased at 16 per cent moisture content. Clay permits better traction than sand except under extreme moisture conditions. The point of greatest efficiency or permissible slip is not constant, occurring later in dry loose soils than in moist compressed soils. A close relation was established between the traction developed by a slowly rotating wheel when advancing and the force exerted by a stationary rotating wheel. A relationship was also established between traction and bearing value, resistance to penetration, and shearing strength of soils. Hardness, cohesive, adhesive, fractional, and puddling properties, tenacity, and plasticity are other soil factors which have assumed considerable importance in this work.

The problem under such analysis has thus resolved it-

*Reprint from the Report of the Work and Expenditure of the Agricultural Experiment Stations, 1922, published by the U. S. Department of Agriculture.

**The numbers in parentheses refer to references that follow this report.

self primarily into one of soil dynamics and the influence thereof on traction. The failure of previous work to yield fundamental information regarding traction obviously has impressed the investigators with the importance of beginning the work with a consideration of the requirements of the thing most vitally concerned, the soil.

Tillage Machinery. Everthing indicates that the more or less neglected soil factor really constitutes the logical starting point for many studies of tillage machinery and should profoundly influence their ultimate trend. For example, E. V. Collins, at the Iowa station, in studies on factors influencing the draft of plows (3, 4, 5), showed that the type of plow bottom does not materially influence the draft, and that an increase in speed will produce about the same increase in draft with any type of bottom. The increase in draft due to speed was found to be confined to that part of the total which is required for turning and pulverizing, and varied with the speed from less than one-third to about one-half the total draft of the plow within a speed range of from 2 to 4 miles per hour. Under some plowing conditions a sharp cutting edge was of little importance, and under certain conditions high speeds caused failure to scour. These results indicate the primary importance of soil mechanics as the controlling factor.

Other plowing tests by J. B. Davidson and Collins, at the Iowa station (6), and of a large number of plowing tests by O. W. Sjogren, at the Nebraska station (7), by M. M. Jones, at the Missouri station (8, 9), and by A. H. Hoffman, at the California station (10), indicated the importance of the soil as a factor for primary consideration in studies of tillage machinery. This was also brought out in a large number of disk harrow tests by Hoffman and E. J. Stirniman, at the California station (11), by Sjorgren, at the Nebraska station (7), by Jones, at the Missouri station (9), and by Collins, at the Iowa station (12, 13, 14).

In a more fundamental study of the plow bottom and its action on the furrow slice, at the New York Cornell station (15), E. A. White attempted to develop a theory for the design of plow bottoms. The results, while inconclusive, gave reason to believe that there is a mathematical form to which the surface of the plow bottom should conform, in view of the fact that the soil particles follow very definite paths when passing over the surface of the moldboard. This work also pointed to the soil as the logical starting point of such investigations.

With this same thought in mind, Hoffman at the California station planned a study which was originally intended to devise a method of measuring the coefficient of static and kinetic friction between any given soil and polished metal surfaces, but which was finally reduced to a study of the factors governing static friction between the metal surfaces of farm machines moving through or over soil and different soil types.

Nichols, at the Alabama station, undertook to develop an even more fundamental conception of the influence of the soil factor on the operation of traction and tillage machines (16). He has pointed out the needs of research along the lines of soil dynamics which will be peculiarly applicable to agricultural engineering requirements. He has also shown that seedbed preparation and cultivation, as well as traction, are processess, the efficiency of which depends upon adapting the implement to the mechanical properties of the soil.

A survey of work on tillage and tillage machinery at a number of the experiment stations and by several private commercial concerns has shown the necessity for an entirely new classificiation of soils and their properties with reference to the engineering aspects of tillage. With this in view, Hoffman, at the California station, has devised a method for measuring and standardizing the state of tilth of soil (17). This method involves the use of six screens of different mesh sizes, placed one above the other, the top screen having an 8-inch mesh, the next a 4-inch mesh, and so on down to the bottom screen, with a 0.25-inch mesh. The soil sample, taken to the depth of tilth in an undisturbed condition, is gently deposited upon the top screen, and the percentage by weight retained by each screen is recorded. Only the 0.5 and 0.25-inch screens are shaken. Curves platted from such data show the states of tilth in different soils and the tendencies of tillage operations in influencing tilth conditions. This method has been recommended as a standard for indicating state of tilth by the Research Committee of the American Society of Agricultural Engineers.

Air Cleaning of Tractor Motors. The work on air cleaning for tractor motors is another interesting instance of the evolution of research in agricultural engineering. The need for work of this character was reflected in a number of the so-called tractor surveys, which have been conducted from time to time by the experiment stations in nearly every state where tractors are used to any extent. This need seems to be especially important in some of the far western and southern states where extremely dusty conditions prevail during parts of the year. A large amount of work of an empirical nature has been done on this subject at great expense by manufacturers of tractor accessories and equipment, but has been limited to the development of mechanical devices.

In preliminary work at the California station (18), Hoffman tested twenty-six air cleaners for tractor motors representing all the more prominent makes and types, the purpose being to compare the dust-separating efficiency, vacuum effect, and effect on maximum possible power of the motor of the different cleaner types. These cleaners included eight of the dry type, nine of the water type, and nine of the oil type. The results showed that the oil types gave the most uniformly efficient results, followed in order by the water and dry types. The effect on power of the engine was found to be negligibly small for the average of each group, but the results were not final.

In further work (19) Hoffman developed methods of testing dust-separating efficiency (20). In order that all aid cleaners might have to meet the same conditions, a standard dust was made up from ten 50-pound samples of field soils taken from ten regions in California where tractor motor wear due to dust conditions is very rapid. By a pulverizing and air floating process, the dustier portions were separated from the rest. This air-floated portion constituted 99 per cent of the standard dust used, and the other 1 per cent was a very fine sand. A small circular brush revolved by a motor swept the dust into the stream of air entering the cleaner under test, and the rate of feed was varied by use of screws of different pitches and by varying the period of a contact pendulum which operated the screws.

Nichols, at the Alabama station, undertook to learn more about the fundamental scientific principles governing the dust and its movement in an air cleaner, and its consequent maximum removal from the tractor air intake within a given range of partial vacua caused by intake suction, and within a given range of amount and of physical, mechanical, and chemical composition of dust. He finally arrived at the tentative conclusion that the solution of the problem rests upon the determination of the factors governing the so-called decolloidization of the dust floating or suspended in the air. His theory is that once the air-floated dust is flocculated it can be controlled and removed by known mechanical principles. Further investigations on the subject are in progress to indicate the principles which, when embodied in any air cleaner, will cause the maximum practical dust removal under the conditions imposed.

Side Draft. Hoffman, at the California station (21), has shown that side draft, the stumbling block in many mechanical tillage devices, is governed by the laws of mechanics that apply to forces in general, and is always in evidence if the resisting force of the implement pulls to one side instead of parallel to the direction of motion. He found that no hitch, patented or otherwise, can prevent side draft when the center lines of pull of a tractor and of resistance of an implement are offset and the hitch is to the center of a symmetrically placed drawbar, but that it can be removed by making these lines coincident.

E. A. White, in a study of equalizers and hitches at the Illinois station (22), evolved a mathematical method by which equalizers and hitches may be analyzed, thereby affording a means of making fundamental comparisons and

when desired of predicting the results as regards side draft, especially what may be expected in a given case.

Miscellaneous Machinery. Davidson and Collins, of the Iowa station, working in cooperation with the soils department of the station, recently completed a study of limestone and fertilizer spreaders (12, 23). Tests of commercial limestone spreaders and a study of the various methods of handling limestone indicated requirements and desirable features of a limestone spreader which eliminated all the commercially available types. The results pointed the way to the development of an effective machine which took the form of a trailer behind a loaded wagon, using a revolving finger type of distributor. This case illustrates an effective way to proceed in such matters, in that it began with a study of what a limestone spreader should do, with special consideration of the properties of the limestone itself, passed through the stages of testing available machines and establishing the engineering principles on which an efficient machine should be constructed, and ended with the actual construction of a satisfactory machine.

F. W. Duffee, of the Wisconsin station, in elaborate tests of the relative efficiencies of twenty different silage cutters and fillers (24), revealed a broad variation in the power requirements of different machines performing the same function, thus indicating that light-draft machines are more the result of perfection of design than of type. The necessity for fundamental studies of the requirements of the processes which must be met by these machines to serve as a basis for their development was thus made evident.

G. R. B. Elliott and J. L. Larson, of the Minnesota station, in their experiments on the first breaking of peat lands (25), found it necessary to develop special types of marsh plows. Here was a case in which studies along one line brought out the necessity of conducting studies along another line before the first studies could be completed—a not unusual occurrence in a relatively new subject such as agricultural engineering.

Farm Structures

There is a long record of work on farm buildings at the experiment stations, most of which, however, has been merely an application of well-known engineering knowledge and skill in the design of farm structures, frequently as a purely service function. Previous to the year 1922 almost every state agricultural college and experiment station engaged in some such work, but instances of serious research in this field have been rare.

Elevators. The Iowa station was one of the first to recognize the importance of putting the studies of farm buildings on a fundamental basis. W. G. Kaiser and W. A. Foster, of that station, conducted studies of farm elevators (26) which brought out clearly the importance of logical starting and finishing points in farm-building studies, and also illustrated the application of engineering and purely scientific principles to such work. The studies began with a consideration of the requirements of the thing most vitally affected, the grain, and ended with the development of elevators designed to handle the grain with a maximum of efficiency.

Roofs. Another instance worthy of mention is the work at the Iowa station by F. C. Fenton and A. W. Clyde (27), which was developed by Clyde into a specific study of self-supporting barn roofs (28). These studies dealt primarily with roofs for different types of barn. Significant conclusions from the first studies were that practically nothing definite is known of the strength of ordinary barn roofs, and that none of the common types will withstand a wind of 90 miles per hour. The results were taken to indicate the need for studies of the strength of the various types of roof with a view to evolving rational methods of design to meet the requirements of self-supporting roofs.

Tests by Clyde and H. Geise (29) of a masonry-arch barn roof, consisting of three reinforced concrete arch ribs filled in between with reinforced clay block, showed that the breaking load was approximately four times that produced by a 90-mile wind and that the design was much heavier than is required in practice. This would point to the necessity for a more thorough study of strength requirements of barn roofs, as a basis for design.

Silos. A considerable amount of work on silos has been done at a number of stations, much of which has consisted largely of comparative tests of different types of structure to suit the requirements of different materials. However, the work at the Iowa station began with a consideration of the requirements of silage making and preservation. The early work of Davidson and M. L. King (30) indicated that the essentials of good silo construction require air-tight walls and doors, walls smooth inside and rigid enough to withtand the pressure of the silage, and an air space between the walls to prevent freezing. Further work by Davidson and King (31) resulted in the development of the silo constructed of reinforced hollow clay building blocks, which embodied nearly all the essential requirements for proper silage making and preservation. Subsequent work by Davidson (32), and by C. K. Shedd and W. A. Foster at the Iowa station (33), resulted in the further fundamental development of types adapted to special conditions, such as the wooden hoop, pit, and monolithic concrete silos.

Further studies at the Iowa station on the influence of silo wall construction on the freezing of silage (34) showed that during cold weather the temperature at the inside of the north wall is only a little warmer than the outside temperature for wood-stave, hollow-tile, or monolithic-concrete silos. This resulted in the conclusion that there is no practical difference between the insulating properties of the three types of construction.

In accordance with a similarly fundamental conception of the silo problem, S. I. Bechdel conducted studies at the Pennsylvania station on the preservation of corn silage (35) in wood-stave, concrete-block, hollow-clay-block, and monolithic-concrete silos. These indicated that maximum temperatures higher than 80 degrees F. are not necessary, that the total acidity of silage near the center is greater than that near the walls, and that near the walls there is proportionately more acetic and less lactic acid due to less firm packing. The proportion of lactic acid developed in stave silos was higher than in the concrete types, but otherwise there were no characteristic differences in the chemical composition of the silage made in the different silos.

With these results apparently in mind, studies conducted at the Iowa station (36) on means of making impervious silo walls constructed of porous materials showed that the application of bituminous material to the surface, by first sizing with a solution of the bitumen and later with a hot application, most satisfactorily resisted the action of the silage and had little tendency to peel or scale off.

Studies were also conducted at the Nebraska station by L. W. Chase (37), on the weight and capacity requirements of silage as a basis for the design of silos for structual strength. This work was elaborated at the Kansas and Missouri stations by C. H. Hicks, O. E. Reed, and J. B. Fitch (38, 39) and established the fact that the weight of silage is subject to so much variation that no table of silage weights and silo capacities can be more than approximately correct.

Ventilation. Considerable interest has been awakened recently in the ventilation of farm buildings not only for animal shelter but for crop storage as well, and the United States Department of Agriculture and several of the stations have entered into investigations of various phases of the subject.

In a study of some of the fundamentals of stable ventilation, H. P. Armsby and M. Kriss, of the Institute of Animal Nutrition of the Pennsylvania State College, in cooperation with the United States Department of Agriculture (40), attempted to show how the results of direct determinations of the heat production of cattle and other stock may be applied to the problems of stable ventilation, and how the heat production in any specific case may be computed with a fair approximation to accuracy. The results showed that the best thermal surroundings for animals should be between a temperature somewhat above the critical point, and one not so high as to affect the appetite and thrift of the animal.

Using the results of the above study as a basis, M. A. R.

Kelley, of the United States Department of Agriculture, studied the factors influencing the operation of dairy barn ventilation systems, with particular reference to the forced-draft system (41). On the basis of the Armsby data for dairy cows, the results showed that as the total heat lost by ventilation and radiation decreased, the temperature inside increased. Estimating the heat production from the individual weight of each cow, the results showed that with the fan system of ventilation, 43.7 per cent of the heat generated by the animals was lost by ventilation and 23.5 was lost by radiation.

In considering the design of outtake flues for dairy barn ventilation with a natural draft system on the basis of the heat and carbon-dioxid production of dairy cows, J. L. Strahan, of the Massachusetts station, showed that different breeds of dairy cows present different requirements (42). It was found that with a natural draft system it will be reasonable to expect Holsteins to maintain in zero weather a temperature above freezing in a stable 36 by 80 feet inside and housing 40 cows, and at the same time possible to maintain adequate ventilation conditions. On the other hand, it was shown that if Jerseys in low production are housed the stable temperature will drop below 32 degrees F. as soon as the outside temperature goes below 6 degrees, if the same rate of air flow through the stable is maintained. Under these conditions the air flow would have to be reduced over 1,200 cubic feet per cow in order to keep the inside temperature up, which would tend to lower the ventilation standard considerably.

Kelley undertook a further study of the factors influencing the design and operation of animal-barn ventilation systems, in cooperation with several of the state experiment stations, special attention being paid to horse, hog and dairy barns (43). This study showed definitely that the factors influencing the maintenance of the desired temperatures in animal shelters are (1) insulation, (2) tightness of construction, (3) amount of air space each animal is expected to heat, and (4) the desired amount of ventilation in accordance with the type of animal housed and methods used in securing it. One significant conclusion drawn was that further research is needed on the requirements of horses in particular, upon which to base horse-barn design and ventilation.

In further studies of hog-house ventilation conducted at several of the experiment stations (44), Kelley showed the possibility of maintaining a reasonably uniform temperature in a barn housing a total weight of 26,775 pounds of hogs by regulating the amount of intake openings. This work also indicated the need for further study of the requirements of hogs and of the factors influencing and producing uniform temperature conditions.

Further studies by Kelley (45), in cooperation with the Maine, New York Cornell, and Nebraska stations, on the ventilation of animal shelters and poultry houses, indicated the necessity for more fundamental studies of the ventilation requirements of animals and poultry under exactly controlled conditions. This would suggest the utility in such studies of experimental processes and apparatus similar to those used in respiration calorimetric studies.

Crop Storage. The development of buildings and structures for the storage of crops is a problem of considerable importance in some localities. The importance in such work of careful consideration of the requirements of the crop and its behavior under storage conditions before undertaking to develop storage buildings can not be too strongly emphasized.

Thus studies on the development of potato warehouses by F. E. Fogle, at the Michigan station (46), began with a consideration of the ventilation, temperature, and moisture of the potato itself and of its rotting tendencies in storage, and proceeded ultimately to the development of the warehouse equipped with a suitable ventilation system for Michigan conditions.

Studies at the Delaware station by T. F. Manns on sweet potato storage in Delaware (47) dealt first with diseases of the sweet potato and the influence of moisture, ventilation, and temperature upon storage roots of sweet potatoes, as basic considerations in the development of storage houses and ventilation systems.

These and many other studies at the stations on crop storage show how consideration of the requirements of the crop and its behavior under storage furnishes a basis for the intelligent development of storage structures, and that cooperation between the agricultural engineer and other specialists is of great importance in such work.

(To Be Concluded in the January Issue)

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Agricultural Engineering Digest

A review of current literature on agricultural engineering by R. W. Trullinger, specialist in rural engineering, Office of Experiment Stations, U. S. Department of Agriculture

The Penetration of Bacteria Through Capillary Spaces. II Migration Through Sand, S. Warren and S. Mudd. Journal of Bacteriology, Baltimore, 9 (1924), No. 2, pp. 143-149.) In a contribution from Harvard University studies are reported which resulted in the development of a method of allowing bacteria to migrate through sand, by which micro-organisms of very high motility may be selected. Each strain of bacteria reaches a certain maximum level of activity which is retained only so long as rapid transfers are made. The method is also adaptable for separating motile and nonmotile organisms. The maximum rates of migration through quartz sand attained by the different organisms tested were for Vibrio cholerae 0.55 centimeters per hour and for V. percolans 0.43 per hour. These organisms were found to be subject to positive chemotaxis to nutrient media, and their migration to be determined primarily by the available food supply.

Notes on Strength of Timbers with List of Transverse Tests on Specimens in the Technological Museum, M. B. Welch. ([New South Wales] Technological Museum Bulletin, Sydney, 6 (1923), pp. 12). Data on strength tests of several different Australian timbers are presented and discussed. These included tensile, compression, and shearing tests, and data was obtained on moduli of rupture and elasticity.

Refrigeration Plant Equipment. (Chicago: Technical Publishing Company, 1923, pp. 94, figs. 34). This publication contains chapters on mechanical refrigeration and mediums, refrigeration and mediums, refrigerating and ice-making systems, ammonia compressors and their operation, construction and care of ammonia condensers, direct expansion for refrigeration, brine used as refrigerating medium, water handling in the ice plant, and construction and care of ice tanks.

Piping for Power and Heating Plants. (Chicago: Technical Publishing Company, 1923, pp. 128, figs. 77). Chapters are contained in this publicatiion on installation of piping systems, construction of pipe joints, pipe fittings and bends, expansion in piping, materials used for piping, corrosion of piping and its prevention, radiation losses from pipes, pipe capacities and friction losses, water piping systems, steam piping—mains and headers, piping connections to power plant equipment, and piping for exhaust steam heating systems.

Does the zn/p Function Fit the Facts? A. E. Becker. (Industrial and Engineering Chemistry, Washington, D. C. 16 (1924). No. 8 pp. 856, 857, figs. 3). Data are presented which are taken to indicate that the theories which have been advanced in regard to the zn/p relation in the lubrication of bearings fail to fit the facts. This relation is that for a given bearing and a given oil, changes in the coefficient of friction are determined largely by the modulus zn/p, in which z is the viscosity of the oil at the temperature of the oil film, n represents the revolutions per minute, and p is the nominal pressure on the bearing in pounds per square inch.

Hatching Chicks Electrically, H. E. Bell. (Journal of Electricity, San Francisco, 53 (1924). No. 3, pp. 85-88, figs. 7.) In a contribution from the Oregon Agricultural College data on the operation of an electrically equipped incubating plant on the Pacific coast, having a capacity of 80,000 eggs, are presented. The plant consists of a wooden building 44 by 150 feet which contains 131 incubators with a capacity of 612 eggs each. Double walls packed with sawdust for heat insulation are used, and the floor is covered with dirt and a layer of sawdust and shavings to reduce heat radiation. The building is heated by the incubators alone, and the temperature varies from 60 to 70 degrees F. Each incubator is heated by ten elements which are placed at the top of the incubator and spaced 7 inches apart, with 6 inches from the end elements to the end of the compartment.

Tests showed that the power in each individual machine was on for very short intervals of time only. The current in no machine remained on for more than a minute to a minute and a half, with the exception of the time necessary to reheat the eggs after cooling or turning, during which period the current remained on for an hour at a time. The power consumption was found to drop off on the fourteenth day due to the fact that the growth of the germ at this period begins to use the latent heat stored within the egg. The energy used during the first day was found to be relatively high on account of the initial heating of both the incubator chamber and the eggs. The daily consumption then remained constant at 4 kilowatt-hours per day until the fourteenth day. From this time on until the chick was hatched, the consumption gradually fell off and dropped as low as one kilowatt-hour per day with a room temperature of 65 degrees.

Tests to determine the voltage regulation and the number of interruptions to service showed that the power went off on an average of once in every three days, but only once a season for a long enough period to require the starting of an emergency plant. The voltage had about the same characteristics from day to day with a maximum of 122 volts and a minimum of 114 volts.

A third test showed that the temperature of the room affected the consumption of power material. If the temperature of the incubator room was high, the amount of power used by the machines in operation was lowered. The three factors governing the proper maximum temperature for the room are considered to be the most satisfactory temperature for cooling the eggs, the temperature under which it is possible for men to work comfortably, and the temperature adapting itself to most efficient ventilation. Since the eggs must be cooled down to 98 degrees several times during incubation, it has been found that the room temperature should not go above 95 degrees in order to secure economy of time in the egg cooling process, and an average of from 85 to 90 degrees has been found to be the best.

Ventilation is said to be the most important factor. Experiments showed that when the temperature of the incubator room was raised to 85 or 90 degrees, the ventilation in the type of incubator manufactured today becomes inefficient. However, it was found that a large saving in the cost of power per hatch is accomplished by having the room temperature high. It is stated that another feature of electric incubation upon which experimental study could be advantageously undertaken is that of the most desirable capacity of the heating elements.

Controlling Surface Erosion of Farm Lands, F. L. Duley. (Missouri Station Bulletin, Columbia, 211 (1924), pp. 23, figs. 17.) This report presents the practical features of studies conducted over a six-year period on the measurement of run-off and losses from soil erosion previously reported in Research Bulletin 63 (Agr. Engin. Vol. 5, No. 3, p. 186).

It has been found that deep plowing to 8 inches is only slightly more effective than shallow plowing to 4 inches in preventing run-off and erosion. A growing crop on the land, particularly a small grain or sod crop, furnished the most effective means of reducing erosion. The character of the rainfall largely determined the amount of soil lost. A heavy dashing rain removed more soil within a few hours than was lost during a whole year when the rainfall was well distributed. Grass or clover land absorbed much more water than cultivated land.

The use of cropping systems which include sod crops like clover or other hays is considered to be the most practical means of reducing the surface erosion on rolling lands that must be cultivated a part of the time. It is stated that badly eroded soils may be rejuvenated by the use of crop rotations adapted to poor land provided the proper fertilizer, manure, and lime treatments are applied to the soil. Chemical analyses of the eroded material showed that in many cases as much of the mineral plant nutrient elements may be lost through erosion as would be removed from the soil by average crops.

"Bacteriophage" and Self-Purification of Water, P. C. Flu. (Centralblatt fur Bakteriologie, Parasitenkunde und Infelstionskrankheiten, Jena, Germany, 2. Abt., 59 (1923), No. 12-16, pp. 317-321.) Studies to establish the presence and manner of action in water of so-called bacteriophage or liquid substances imparting the property of self-purification are reported.

The results showed that these substances, if they exist, are of very little importance in the self-purification of water. It was demonstrated, however, that the protozoa are the main controlling factors in the self-purification of water. When the protozoa were killed with potassium cyanid, self-purification of the water did not take place.

Water Purification by Means of Lime in Connection with the Drinking Water Question in the Dutch East Indies, II. J. Smit. (Centralblatt fur Bakteriologie, Parasitenkunde, und Infelstionskrankheiten, Jena, Germany, 2. Abt., 59 (1923), No. 12-16, pp. 322-333.) Studies are reported which showed that treatment of water with caustic lime, followed by filtration through sand or filter paper, removed the pathogenic organisms. Slow sand filtration, while reducing the number of organisms, was not as effective in this respect as rapid sand filtration. The addition of enough lime to produce alkalinity is necessary for good results.

The very turbid waters of Java were clarified and rendered very low in bacterial content by this process. Sedimentation

before filtration was found to be unnecessary for good results. Cholera and typhoid organisms were removed from such water without difficulty. The action of alum was less favorable than that of lime, and it was useless for the removal of pathogenic organisms. Further experiments with dilute lime water showed that the alkalinity produced was very toxic to both pathogenic organisms and B. coli. This is considered to account for the superiority of lime over alum as a water purification medium.

A process combining precipitation for six hours with filtration through fine silica and a thin sand layer produced a filtrate corresponding to good bath water, which had the additional property of self-purification owing to its alkalinity.

Motor-Driven Irrigation Pumping Plants and the Electrical District, G. E. P. Smith. (Arizona Station Bulletin, Auburn, 99 (1924), pp. 67-141, figs. 21.) The primary purpose of this bulletin is to supply practical information on motor-driven pumping plants, both for those who desire to change their pumping plants from engines to motors and for those who desire to install new motor-driven pumping plants. General discussions of wells and pumps are included, and an explanation of the legal character, function, and operation of electrical districts is also presented.

Effects of Storage on Artificially Polluted Waters, R. C. Frederick. (Analyst, London, 49 (1924), No. 575, pp. 63-73.) Studies into the chemical changes which occur in excretally polluted water in storage are reported. The findings were co-ordinated with the results of analyses of nearly 1,000 samples of water from every type of source throughout the British Isles.

Studies to determine comparatively the changes taking place in water polluted with urine, with an equal quantity of feces, and with the same weight of a mixture of equal parts of urine and feces showed that the chemical changes in samples take place comparatively slowly, and that quite different results are obtained according to the nature of the pollution. The analytical results showed that if pollution of the water is very recent, the evidence in the samples will be more pronounced if the analysis is actually delayed for a considerable period.

It was further found that in the case of a very recent pollution, particularly urinary, the free ammonia obtained by distillation is not infrequently evolved in a large number of fractions, each of which, after the first few, contains about the same amount as that immediately preceding. In samples in which pollution is more remote, the free ammonia is completely evolved in a small number of fractions which show progressively a distinct fall in amount.

Recent pollution is indicated by distinct evidence of free ammonia. It was found that, of waters considered fit for potable purposes, none contained free ammonia in excess of 0.003, albuminoid ammonia in excess of 0.008, or nitrites in excess of 0.0001 part per 100,000, after excluding samples which could have derived these substances from other than excretal sources. It is concluded that these are the limits which, if exceeded and a nonexcretal origin can be excluded, provide definite evidence of excretal pollution. It is also concluded that the nitrates should not exceed 0.05 part per 100,000.

It is pointed out that it is not necessary to exceed all these figures to cause suspicion. A distinct excess of any one is sufficient, although the occurrence of only a single abnormality is said to be uncommon. Attention is drawn to the fact that in the polluted waters considered, the limit for free ammonia was not exceeded in 32 per cent of the cases, for albuminoid ammonia in 16, and for nitrites in 14 per cent.

It was further found that exposure of samples of water to light resulted in an enormous increase in the albuminoid ammonia content due to the growth of algae, but for all practical purposes there was no effect on the rate of production and the amount of free ammonia and nitrites. This is considered proof that there is a fallacious increment to, and not a decrement from, the indications of pollution on storage in light, as is commonly supposed.

The presence of 0.1 part per 100,000 of copper sulphate in samples stored in the dark very greatly restrained the production of free ammonia and entirely inhibited its oxidation into nitrites and nitrates, thus preventing to a great extent the creation of evidence of original pollution. Chlorination to the extent of 3 parts per 1,000,000 of samples stored in the dark completely prevented, for all practical purposes, the production of free ammonia, nitrites, and nitrates, and even one-fourth of this amount of chlorination was only slightly less effective.

A Bacteriological Study of a Sewage Disposal Plant, W. H. Gaub, Jr. (New Jersey Station Bulletin, New Brunswick, 394 (1924), pp. 24, figs. 4.) Studies on the nature and work of the bacteria and their relative numbers as found in the effluents of the various units in a sewage disposal plant are reported.

The results showed that there is a continual decrease in the number of bacteria in the plant used, which consisted of Imhoff tanks, sludge drying beds, and trickling filter beds. The average final percentage of reduction throughout the four seasons of the year was 95 per cent at 37.5 degrees Centigrade and 94.3 per cent at 20 degrees. The effluent from the plant caused an increase in the number of bacteria in the stream in which it empties, but this increase was entirely eliminated in a distance of 450 feet.

The intestinal bacteria were found to predominate throughout the plant, there being a gradual increase in the percentage of intestinal bacteria in all units preceding the sprinkling filter beds. A decrease in the percentage of these bacteria was found in the sprinkling filter beds and in the remainder of the units of the plant.

Sulphur oxidizing bacteria were found in greatest number in the effluents of the sprinkling filter beds and final settling tank. Sulphate reducing bacteria were found in the raw sewage and in the effluents of all units, the greatest number being in the raw sewage. Proteolytic bacteria, both gelatin liquefying and casein digesting, were found in the effluents of all units. In the final settling tank only the gelatin liquefying type of proteolytic bacteria was found. The effluent from the Imhoff tanks contained the greatest number of these proteolytic bacteria. Cellulose decomposing bacteria were found only in the concentrated sewage effluent of the Imhoff tanks and sprinkling filter beds. Ammonifying bacteria were found in the effluent of all units, while nitrifying bacteria occurred in great numbers only in the effluent of the sprinkling filter beds. The latter were present in the Imhoff tanks after a long incubation period and in much smaller numbers.

Intestinal aerobic and anaerobic bacteria were the predominating types occurring in the sludge. The nitrifying type were found in the sprinkling filter beds, but none occurred in the raw sewage or in the effluent from the Reinsch-Wurl screen. The effluent from the Imhoff tanks contained only a relatively few nitrifying bacteria, and that from the sprinkling filter beds and from the final settling tank contained them in the greatest numbers. The relative stability of the effluents of the various units was found to increase with the successive units in the process of treatment.

Book Reviews

"Modern Farm Machinery," by D. N. McHardy, N. D. A., A. I. A. E., is a new book just published by an English publishing house. In this book the whole range of implements and machines which enter into up-to-date methods of farming is comprehensively dealt with. The aim throughout is to show the principles of construction and the working of each machine, in order that the operator may use it to the best advantage, and be able to deal successfully with any difficulties which may arise. The book deals mainly with mechanical aids, production, and, to a certain extent, with transporting machinery, and is of considerable value as the author has had extensive experience in working with agricultural machinery. It contains shapters on mechanical principles employed in farm machinery; materials and methods used in the construction of farm machinery; the plow; operation of the plow; special purpose plows; drainage machinery, harrows, and rollers; rotary tillage; seeding machinery; artificial manure distributors; root growing machinery; grass mower and hay harvesting machinery; reapers and binders; stationary motors for farm work; barn machinery; cream separators; threshing machines; ensilage cutters; elevating machinery; farm transport, electricity on the farm, and the farm workshop. The book contains 230 pages of text matter and 150 illustrations. It is published by Methuen & Company, Limited, London. The price is 7 shillings 6 pence net.

"Problems in Architectural Drawing," by Franklin G. Elwood, head of the department of architectural and mechanical drawing, Mooseheart, Illinois, is the title of a new book which has been published to fill a need for a text book on elementary architectural drawings, combined with well chosen problems. It presupposes a preliminary course in mechanical drawing, thus rendering unnecessary illustrations of instruments and the repetition of rules for their use. The book is divided into two main parts: The first contains explanations of the best methods employed in architectural drafting, also including general reference work covering typical frame and masonry construction, and contains chapters on architectural drafting, design and construction, construction-carpentry, construction-masonry, and strength of materials. The second part is a logically arranged series of problems from which the teacher may select those best adapted to his own conditions and needs. The problems are presented in a form which requires individual effort on the part of the student, not merely copy work. This part is divided into four groups, including shelters and one-room structures, one-story buildings, two-story buildings, and masonry buildings. The book is published by The Manual Arts Press, Peoria, Illinois. The price is $2.25 postpaid, a discount being allowed for quantity purchases.

"Fundamentals of House Wiring," by George A. Willoughby, supervisor of electrical work, Arthur Hill Trade School, is a new book which presents the practical details of house wiring. It is written as a text book for electrical construction classes in schools, but is also of value to one who desires information on wiring his own house or other buildings. The value of the ability to make house wiring installments, to undestand what is back of a good electrical installation, to select good materials, etc., and to appreciate the duties of an electrical worker have been recognized by the author. The book covers the wiring of old buildings as well as new. A very hepful feature of the book is the summary of each chapter, followed by questions on the text of the chapter. The book contains chapters on important points to consider, suggestions for safe installations, service arrangements and cabinets, wiring new buildings by the knob and tube method. The book is well illustrated and is published by The Manual Arts Press, Peoria, Illinois. The price is $1.00 postpaid.

News Section

Farm Machinery Engineers Meet in Chicago

(Continued from Page 275)

he has developed for use with a grain binder. Prof. Wooley showed several lantern slide views of his machine.

While last on the program, the paper, entitled "The Menace of Foreign Agricultural Competition and Its Agricultural Engineering Aspects", presented by A. P. Yerkes, of International Harvester Company, was far from being the least in importance and interest. Mr. Yerkes had a message of tremendous significance to agricultural engineers, to the farm-equipment manufacturing industry, and to the American farmer. For some time farm organization leaders have been more or less concerned with the competition that the products of American farms are meeting in foreign markets. Because of high priced land and high cost of production the American farmer is being placed at a serious disadvantage when compared with farmers in other countries who have the advantage of cheap land and cheap labor, who are also now following the American farmer's example of using mechanical power and labor-saving equipment very efficiently and on a rapidly increasing scale. As pointed out by Mr. Yerkes, the solution of this problem is one which involves largely the application of agricultural engineering, particularly mechanical power and labor-saving machinery.

The discussion following Mr. Yerkes' paper was led by Roy E. Murphy, manager of Forestdale Farm, Burlington, Iowa, who related his very interesting and instructive experiences in the complete elimination of horses from his 200 acre farm, and the resulting tremendous saving in costs. Discussion of Mr. Yerkes' paper was also participated in by Prof. E. W. Lehmann, of the University of Illinois.

During the course of the discussion of Mr. Yerkes' paper several of those in attendance expressed regret that in the agricultural commission recently appointed by President Coolidge there was not an outstanding agricultural engineer represented on the commission, and a motion was made and carried expressing the sense of the meeting that the American Society of Agricultural Engineers should recommend to President Coolidge that a qualified agricultural engineer be made a member of the commission.

In addition to the program of papers and discussions which featured the morning and afternoon sessions, a special luncheon and good fellowship get-together was held between these sessions, which was attended by a total of sixty-five of those in attendance at the meeting. In the course of the luncheon, at which O. B. Zimmerman presided as toastmaster, each man was asked to introduce in turn the man seated at his left. This served to help get everyone acquainted and contributed greatly to the spirit of good fellowship which was much in evidence throughout the meeting.

The subject of research in farm equipment featured the talks at the luncheon. Vice-president O. B. Zimmerman opened the discussion by a brief talk on the need and possibilities of research in the farm-equipment field and pointed out the opportunities which await agricultural engineers in both the industrial and agricultural fiel dsalong these lines. J. B. Davidson, professor of agricultural engineering and head of the department at Iowa State College, outlined the approach that is being made by the national Committee on the Relation of Electricity to Agriculture to the problem of research involved in the application of electricity to agriculture, in which farm equipment plays a very important part. The attitude of the Committee on Research of the Society, on the need for a real program of research as the basis for greater development both in the farm-equipment industry and the agricultural industry and the basis on which such a program might be worked out through the cooperative efforts of agricultural engineers, manufacturers, and agricultural experts, had previously been outlined briefly by R. W. Trullinger, chairman of the Committee. Mr. Trullinger's paper was read by the secretary of the Society, Raymond Olney, at the luncheon.

Those in attendance at the luncheon listened with a great deal of interest to a talk by R. B. Lourie, vice-president of John Deere Plow Company, on the activities of the joint committees on cooperative relations which were organized about a year ago to encourage and promote closer relationship between the farm-equipment industry and the College Division of the Society. Mr. Lourie is the chairman of the committee from the National Association of Farm Equipment Manufacturers.

Because of the enthusiasm and interest manifested throughout the entire session, it indicates that the meeting has served a real need and that more meetings of this kind, in addition to the annual meeting of the Society, are desirable in the future. Because of the great variety of farm equipment and the extent of the industry, it is necessary to hold meetings during the year in addition to the annual meeting in order that important problems associated with various lines of equipment may be properly dealt with through such meetings of engineers. The opening remarks of Vice-president Zimmerman relative to the quality of A. S. A. E. meetings from the standpoint of the engineer are especially significant. The problems confronting agricultural engineers are indeed without number. The profession of agricultural engineering is still new, and it may be said that we have only begun to develop a real science of agricultural engineering as compared with developments already attained in other engineering fields. For that reason frequent meetings of engineers in th agricultural-engineering field are highly important and essential to the most rapid development of the profession.

Agricultural Engineering Department at South Dakota State College

PRESIDENT C. W. PUGSLEY, of the South Dakota State College, announces the establishment of a department of agricultural engineering at that institution by the state board of regents. Ralph L. Patty (Mem. A. S. A. S.), for eight years extension specialist in agricultural engineering at that institution, has been chosen to head the new department.

President Pugsley, in making the announcement, said, "This new course will fill a long-felt need at South Dakota State College and will conform to similar departments found in other land grant colleges. Farming is coming more and more to be a problem of engineering. With the increased use of farm machinery and farm power and with drainage and irrigation becoming necessary in many localities, agricultural engineering is coming to be one of the most important phases of farming. Apparently the men of Lincoln's time who established land grant colleges had great vision when they stipulated in the Morrill Act of 1862 that training in both agriculture and engineering should be given in the land grant colleges. Recent developments in South Dakota and in other states have showed the wisdom of their vision because agriculture is becoming more an engineering problem each year. The new department of agricultural engineering at State College will be the connecting link between the divisions of agriculture and engineering and will apply the principles of civil, electrical, and mechanical engineering to the problems of agriculture."

Prof. Patty is exceptionally well fitted to assume charge of the new department. He was born on an Iowa farm and following his graduation from high school, farmed two years for himself. He spent some time in the machinery business with his father. Graduating from Iowa State Teachers' College in 1907, he taught school for several years, serving for four years as principal of Brookings, (South Dakota) high school. He returned to the Iowa State College, Ames, and was graduated from the agricultural engineering course in 1916. His scholastic ability

there gained him the honor of election to Tau Beta Pi, the national honorary engineering society.

For the past eight years, he has been with the South Dakota State College as extension specialist, devoting most of his time to problems of drainage, irrigation, farm building construction, and farm home improvement out in the state. Patty is well known throughout the state and is thoroughly familiar with the agricultural-engineering problems. He will continue to give part of his time to extension work this year, devoting the rest of his time to organizing the new department.

Every phase of agricultural engineering will be covered by the course as outlined by Prof. Patty. Drainage, irrigation, farm machinery, farm power, farm motors, farm sanitation, forge work, carpenter shop work, farm building and construction, farm home improvement and tractors will be included in the course of study. Prof. J. A. Bonell and E. O. Gottschalk, who have been giving the work in farm engineering, will continue on the instructional staff.

A Step Toward International Standardization

A FIRST step which may eventually lead to the establishment of a world standard for bolts and nuts was taken at a conference in New York, October 28, 1924. There were present at the conference, which was held under the auspices of the American Engineering Standards Committee, representatives of the German, Czechoslovakian and American national standardizing bodies.

Soon after the war the Germans adopted national standards for bolts and nut diameters and corresponding wrench openings. This was followed by similar action in Austria, Holland, Sweden, and Switzerland, which followed the German work in the principal dimensions, with the result that nuts, wrenches and bolt heads are interchangeable in all of these countries. Czechoslovakia, Hungary, Norway, Poland and Russia are likely to adopt the same standards as the Germans.

In the United States, a large amount of work has been accomplished in the last two years by a large sectional committee on bolt, nut and rivet proportions, under the sponsorship of the American Society of Mechanical Engineers and the Society of Automotive Engineers. This committee contains more than fifty members representing about thirty national organizations, as the subject is a far-reaching one, affecting nearly every industry.

In adopting their present standards, the continental countries thought they were closely following American practice. Essentially what they did was to follow the so-called "United States Standard", rounding the wrench openings to the nearest millimeter.

It was natural for the Europeans to assume that these represented actual American practice, since they are widely quoted in textbooks and handbooks, under the misleading title of "United States Standard Bolts and Nuts". The American representatives stated that in fact these now represent less than three per cent of the production in this country.

The bulk of the present production (except in the automotive and agricultural machinery industries) follows what are called "shop standards" which have heads and nuts about 1/16 inch smaller than the so-called "U. S. Standard" The American sub-committee after an extensive study and conference has proposed a series which is still smaller by about 1/16 inch. The formulas upon which the three series one inch and below, are based are

"U. S. Standard" = 1.5 diameter of bolt plus 1/8 inch.

Present "Shop Standard" = 1.5 diameter of bolt plus 1/16 inch.

Proposed American Standard = 1.5 diameter of bolt.

The conference discussed at length the advantages and disadvantages of the three systems, the manufacturing and commercial questions involved. The Americans presented the results of extensive tests, most of which were carried out by the Bethlehem Steel Company in which actual service conditions were closely simulated. These show conclusively that the proposed series of nuts are in all cases much stronger than the thread on the bolts, that is the threads stripped off before the nuts failed. The Germans reported similar results from investigations which they had carried out.

The Americans pointed to the experience of the automotive and agricultural machinery industries as confirming the soundness of their proposed standards. In both of these, bolt and nuts sizes which are practically the same as those of the proposed standard, have had long practical use. In automobiles finished nuts and bolts have proven satisfactory in fifteen years experience. On the other hand, in agricultural implements the small sizes, as applied to rough bolts, have given good service over a period of thirty years.

The Europeans stated that in all the continental countries the opinion was very strong that the same wrench opening should be used for the nut and the bolt head. In many sizes the prevailing American practice is to make the head 1/16 inch smaller than the nut, but in the proposed series they will be the same in most sizes.

The European representatives stressed the importance of the export trade and the unsatisfactory conditions which result from competing national standards. They also emphasized the great expense and trouble which would be entailed if they were to change their standards which have now been adopted so extensively throughout continental Europe.

It was unanimously agreed by all present that world-wide uniformity in wrench openings is so important that it would be desirable to discuss the matter in the near future in a general international conference. It was agreed that each of the groups would take up the matter of such a conference with its own national standardizing body.

Other important technical points were discussed, including tolerances for round stock and the quality of the material used.

It was interesting to note that while American bolt and nut manufacturers use material with a content of manganese up to 0.60 per cent and a phosphorus content not over 0.10 per cent, the German manufacturers use a material containing no manganese and up to 0.40 per cent phosphorus.

The delegates present were: Czechoslovakia, Dr. Edward Schmidt, Skoda Works, Prague; Germany, Dr. Gustav Schmidt, president of German Bolt and Nut Manufacturers' Society; Werner T. Schaurte, president, Bauer & Schaurte, Rhenish Bolt and Nut Works, Inc; Alfred Dorn, mechanical engineer, German Standards Committee; Dr. William F. Durand, president-elect, American Society of Mechanical Engineers; Prof. A. E. Norton, chairman, American sectional committee on bolt, nut and rivet proportions; E. Burdsall, Russell, Burdsall & Ward Bolt and Nut Company; J. H. Edmonds, Bethlehem Steel Company; M. C. Horine, Society of Automotive Engineers; P. G. Lang, Jr., engineering division, American Railway Association; J. H. Vermeulen, Railway Car Manufacturers Association, and W. S. Swain, Billings & Spencer Company.

Survey of Farm Sanitation Problem in West Virginia

THE West Virginia agricultural experiment station has recently undertaken a survey of the status of farm sanitation in the state. This work is under the direct supervision of F. D. Cornell, Jr., (Assoc. Mem., A. S. A. E.) in charge of agricultural engineering work at West Virginia University.

The purpose of the survey is to find out, if possible, just how much of a farm sanitation problem the state of West Virginia has, in order to permit of the constructive planning of a comprehensive extension project along this line. Communities in which to make the survey were chosen in sections of the state where the different types of farming are found. In this connection, in choosing the communities in which the survey was to be made care was taken to see that the best, medium, and poorest communities were represented. This was done with the idea that in this way

a fairly accurate cross section of actual sanitary conditions could be obtained.

A personal visit was made to each farm and much of the information obtained was recorded only after personal observation of conditions. In this way the data obtained was first hand and reliable. To date two hundred such records have been obtained and will be of exceptionally valuable help in planning an extension project in farm sanitation.

Rural Electrification Project in South Dakota

A RURAL electrification project, sponsored by the national and state Committees on the Relation of Electricity to Agriculture, was gotten under way several months ago in South Dakota. The rural community in which the experimental line is located is near Renner. The project has developed rapidly in the last few months and the patrons are beginning to realize the economy in using the three cent energy, which is the rate fixed after the monthly charge is paid and the first 300 kilowatt-hours have been used.

A tour of the experimental line was held on November 7, the object of which was to give the patrons on the line a chance to see the electrical equipment and installations on each of their neighbor's farms. Many interested visitors were invited and entertained. A buffet luncheon was served all visiting guests by the Ladies Aid Society of the village of Renner, after which short talks were called for from representatives of the state Committee on the Relation of Electricity to Agriculture, the college committee, patrons of the line, and the press. The purpose and plan of the project was outlined by the project director, Ralph L. Patty, head of the new agricultural engineering department just established at the South Dakota Agricultural College.

Twelve of the seventeen farms on the line were visted during the tour. Barns, milkhouses, shops, and homes which have been electrically equipped were inspected. The spectators saw feed ground, milking machines driven, water pumped, grain cleaned, butter churned, cream separated, food cooked, and emery wheels, steel drills, grindstones, meat grinders, washing machines, wood lathes, and circular saws—all run by electricity. They saw a wagon dumped and grain elevated by an electric motor. In the homes they saw innumerable electrical devices, such as vacuum cleaners, electric irons, electric grills, iceless refrigerators, and electric heaters.

Of the heavier energy consuming electric equipment on this experimental line, the South Dakota project now has six milking machine motors in operation; three 5-horsepower motors grinding feed and shelling corn; six utility motors driving lineshafts ranging from ½ to 2 horsepower; nineteen motors pumping water; sixteen motors running washing machines; and three electric refrigerators. Practically all of this electrical equipment has been purchased outright by the farmers on the lines, with the exception of two or three feed-grinder installations which have been loaned for a trial period.

The last stop of interest on this tour was at a dairy farm where the spectators saw a large herd of Holsteins milked by an electrically-driven milking machine.

Bulletin on Commercial Engineering

THE Bureau of Education of the U. S. Department of the Interior has just issued Bulletin, 1924, No. 16 "Objectives in Commercial Engineering," which is a report of the second conference on business training for engineers and engineering training for students of business held at Pittsburgh, Pennsylvania, May 1 and 2, 1922, and was prepared by Glen Levin Swiggett, specialist in commercial education of the Bureau of Education, and chairman of the committee on commercial engineering. Copies of the publication may be procured from the Superintendent of Documents, Government Printing Office, Washington, D. C., at ten cents a copy.

The main topics discussed at this conference included class practices in colleges and universities relating to business training for engineers and engineering training for business, coordination of college training with the industrial demands, civic and social training of the engineer and business man, and training of the engineer for management of overseas engineering projects. The discussion of these topics was participated in by prominent business men and university deans of commerce and engineering.

Methods of Rating Rivers

THE U. S. Geological Survey has proposed to the American Engineering Standards Committee that a national agreement be worked out on methods of rating the water power of rivers. In the request it is stated: "The engineers of the U. S. Geological Survey have struggled with the problem of rating rivers * * * and have within a few years adopted the rule of rating on the basis of 50 per cent and 90 per cent flow. This rule has been adopted by other organizations but is by no means universally used. There is therefore much confusion in statements relating to the capacities of rivers for developing power and a real need for the adoption of a standard. The necessity for a standard was obvious at the World Power Conference in London, as statements of power resources for different countries were made on different bases and therefore were not comparable. Any action taken in this country should recognize the practice in other countries and should conform, if practicable, to a world standard."

In response to this request the A. E. S. C. will communicate with other organizations which may be interested, and if the general sentiment is in favor of the undertaking a sectional committee will be organized for the work. Expressions of opinion on the subject are invited by the American Engineering Standards Committee, 29 West 39th Street, New York City.

Student Branch Activities

An Agricultural Engineering Tour and Demonstration

By Virgil A. Michael
Senior Student, University of Nebraska

GOING to class and "lab" every day can be pepped up considerably by a few outside activities, say the agricultural engineers at the University of Nebraska. With Prof. C. W. Smith stepping on the accelerator, the student branch of the American Society of Agricultural Engineers at that institution staged the first farm tour and demonstration program for farmers that has ever been given by students of the Nebraska agricultural college. On the evening of November 13, they went by automobile to a farm five miles west of Lincoln to inspect the modern improvements, to deliver a properly constructed feed bunk made in the agricultural engineering shops, and to eat a big feed.

They went on a few miles farther to Denton Hall where the County Extension Agent J. F. Purbaugh had arranged for a farmers' meeting. The hall was packed with practical farmers who were keenly interested in the demonstration given there, because the problems had to be solved by them throughout the entire year. The afternoon and evening were so enjoyable that the men are already planning for another meeting in some other part of the county soon.

The demonstrations as given at Denton were each presented by a group of three men. One man was the leader of the group and did the explaining while the other two men did the mechanical work of disassembling and adjusting the apparatuses. Before each demonstration, mimeographed literature used as a guide by the boys demonstrating, was given out as valuable information to the farmers who took it home with them to use in the future. Demonstrations were given along the lines of work which the students were

studying in their class work every day. They were prepared without any great amount of additional work yet the knowledge was fresh in their minds. Demonstrations were presented on soldering, the valve timing of stationary engines, adjustment and timing of a magneto, saw filing, automobile light adjustment, and the adjustment of a binder knotter. By giving these demonstrations the boys gained experience in imparting their knowledge to the public in a very practical way, besides giving the public some very valuable information which could be used at any time.

While the boys were getting ready for the next demonstration the intermissions were filled by talks, clown acts and songs. The talks were along some other line than that of agricultural engineering, nevertheless they appealed to the agricultural class of people.

The visit to the modern farm was a very profitable one to the group. It was a modern dairy farm situated five miles west of Lincoln. The boys were shown through all the buildings where they found some very unique arrangements pertaining to agricultural engineering. The house was modern in every respect. Electric lights and power were furnished the house and all of the outbuildings by a 32-volt electric plant located in the basement of the house. Here was also installed a pressure tank for supplying water. The house was heated by a pipe furnace located in the basement. The basement was also equipped with fruit storage, fuel and wash rooms. There were two entrances to the basement, one from the outside of the house and one from the kitchen. The outside entrance was fixed with a double door so that only one door could be used at a time or both doors in case it was necessary to take large articles into the basement.

The barn was built in a hillside so the haymow floor was even with the ground level on one side and the other side was enough lower to permit stock below. The stock were housed in the basement of the barn, so to speak. This unique arrangement facilitated the handling of feeds and provided very comfortable quarters for the stock both in summer and winter. Taking advantage of nature's hillside, with these handy arrangements fifty head of Holsteins were fed and milked in about four hours time every day.

The combination corncrib and machine shed was also very handily arranged. The crib was filled by a pit elevator in the driveway of the building. The elevator was operated by a tractor which was stored in the machine shed on the opposite side of the driveway.

It was at this farm the boys delivered the new cattle feed bunk made by them in the agricultural engineering shops. They were also the first ones to eat from it, the menu consisting of "hot dogs" buns, baked beans, coffee and apples. This menu was probably somewhat different than that later served in it, but it "hit the spot". It was a very welcome sight to a group of fellows who had not seen any eats since noon and who had driven five miles and visited a modern farm before they got them. They (the eats) did not last long.

The whole program was a real success, so much so that we are already planning another. A great deal of the success of the program was due to Prof. C. W. Smith who was the instigator and promoter, with the hearty cooperation of the county agricultural extension agent who secured the place for them and advertised it in the community.

New A. S. A. E. Members

Wallace M. Cooper, manager Los Ganos Estate, Guantanamo Sugar Company, Guantanamo, Cuba.

TRANSFER OF GRADE

Jesse Harold Neal, instructor in agricultural engineering, University Farm, St. Paul, Minnesota. (From Student to Junior Member.)

Dale Lester Renner, principal of Albion High School, Albion, Nebraska. (From Student to Junior Member.)

Applicants for Membership

The following is a list of applicants for membership received since the publication of the November issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for the consideration of the Council prior to election.

Albert E. Backman, assistant engineer appraiser, Federal Land Bank, Berkeley, California.

Alfred C. Boock, mechanical engineer, in charge of farm engines, Fairbanks, Morse and Company, Beloit, Wisconsin.

F. W. Jones, contact man on machinery advertisers accounts, Western Advertising Agency, Racine, Wisconsin.

Charles M. Packham, factory representative for manufacturers' sales, The Bassick Manufacturing Company, 2650 North Crawford Avenue, Chicago, Illinois.

John Stanley Winters, instructor in agricultural engineering, University Farm, Davis, California.

TRANSFER OF GRADE

S. Stanley Graham, associate professor of agricultural engineering, Sam Houston State Teachers College, Huntsville, Texas. (From Junior to Associate Member.)

Willis S. Rosing, Osceola High School, Osceola, Iowa. (From Student to Junior Member.)

Franklin J. Zink, assistant engineer, Iowa Engineering Experiment Station, Ames, Iowa. (Mail) Garner, Iowa. (From Student to Junior Member.)

A. S. A. E. Employment Service

This service, conducted by the American Society of Agricultural Engineers, appears regularly in each issue of Agricultural Engineering. Members of the Society in good standing will be listed in the published notices of the "Men Available" section. Non-members as well as members, are privileged to use the "Positions Available" section. Copy for notices should be in the Secretary's hands by the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. No charge will be made for this service.

Men Available

AGRICULTURAL ENGINEER, 1923 graduate of Kansas State Agricultural College in agricultural engineering, desires to make a change. Work along engineering lines is preferred. Address M. S. Cook, 5406 Ferdinand Street, Chicago, Illinois. MA-121.

AGRICULTURAL ENGINEER with experience on large farms with all kinds of machinery and equipment wants position with manufacturer of farm equipment. MA-122.

AGRICULTURAL ENGINEER wants position with contractors doing work in farmstead planning and building. MA-123.

AGRICULTURAL ENGINEER open for position as sales engineer, salesman, advertising writer, or agricultural propagandist. Past experience with large agricultural firms. MA-124.

Positions Open

AGRICULTURAL ENGINEER to handle farm machinery, farm power, and related lines of work needed to fill vacancy in the department of agricultural engineering at the University of Idaho, Moscow. Man selected will have the major portion of his time taken up with teaching but will have some time and opportunities for research work. Address E. J. Iddings, dean and director, College of Agriculture.

AGRICULTURAL ENGINEER equipped with good training and experience in agricultural engineering, preferably familiar with New England agriculture, is wanted by state agricultural experiment station in one of the New England states, to take charge of experimental work on rural electrification projects. Write the Secretary of the American Society of Agricultural Engineers.

AGRICULTURAL ENGINEER to handle extension work in farm power, machinery, and land reclamation, at the Kansas State Agricultural College. If interested, send statement of training and experience. Address, Department of Agricultural Engineering, Kansas State Agricultural College, Manhattan, Kansas.

AGRICULTURAL ENGINEERING

THE JOURNAL OF THE
AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

A S A E

DECEMBER-1924

"If we have not the capacity as a nation to regulate these great tools in the public interest," it is Secretary Hoover's conviction, "we much less possess the capacity to operate them on behalf of the Federal Government."

Senator Arthur Capper of Kansas in a talk which was also radiocast to five million people, likewise expressed his confidence in these regulated companies. Because of their record he expressed the belief "that the application of power to agriculture for the mutual benefit of the farm, electric light and power industry, and the nation as a whole, is in hands that may be trusted to find a mutually advantageous solution."

U. S. Senator Arthur Capper Kansas

And because so many consumers of electricity own securities of the companies Senator Capper said that the electric light and power industry "is becoming in an increasing degree a great community enterprise. This, in my opinion, is public ownership at its best."

LIGHT ASSOCIATION

Directory of Professional Agricultural Engineers

CLARK E. JACOBY ENGINEERING COMPANY
Consulting Engineers
Drainage, Land Reclamation, River and Flood Control, Tiling, Topographic Surveys, Bridges and Reinforced Concrete Structures
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For Consulting Engineers

AGRICULTURAL engineers, who are doing consulting work or who wish to build up a consulting practice, will derive much benefit from carrying an advertisement in this Directory of Professional Agricultural Engineers. All inquiries requesting the Secretary of the American Society of Agricultural Engineers to recommend professional engineers available for consulting service are referred exclusively to agricultural engineers whose advertising card appears in this directory.

Rates for professional cards like the above —size 1 by 3 inches—are as follows:

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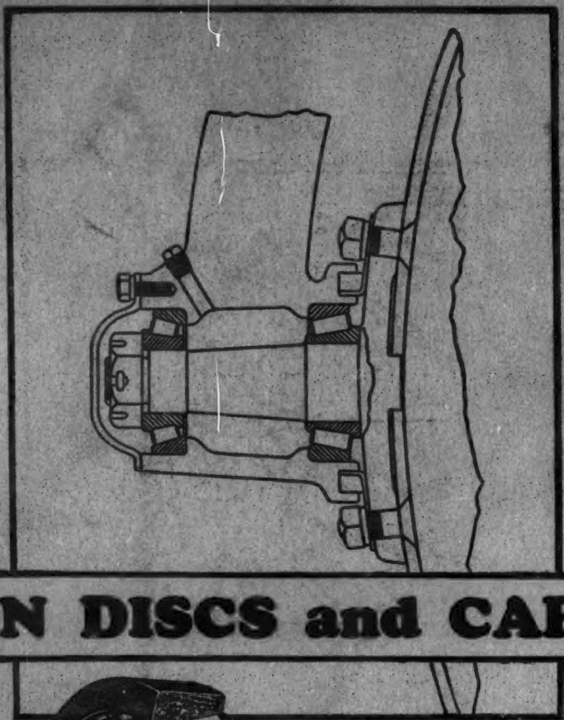

A typical Timken Bearing installation in the spindle of a disc plow.